C1850-2
3/3/87

A CAHNERS PUBLICATION

FEBRUARY 15, 1987

Electronic Business

Factory automation at Westinghouse and IBM

Parallel processing: Strategies for an expanding market

P1372521 (8R01 00000 1 0061 92
ASST MGING EDITOR
CONGRESSIONAL INFO SRVC
SRI ACQUISITIONS
4520 EAST-WEST HWY
BETHESDA MD 20814

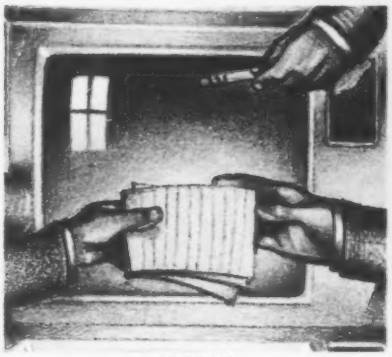
Tandem's Treybig: Fault-free visions of an expanding niche

Electronic Publishing

Electronic Business

VOL. 13, NO. 4 FEBRUARY 15, 1987

THE BUSINESS MAGAZINE FOR THE ELECTRONICS INDUSTRY



PAGE 28

BUSINESS TRENDS

28 Parallel processing: Swapping information internally
Interest in this processing is high in certain circles. But so far it's only a $31 million market.

32 From the Voyager space mission to venture capital
Jet Propulsion Labs is now offering technology to local electronics firms.

39 MRO sales: Going strictly by the book
In distribution, the maintenance, repair and operations segment is faring well these days.

46 One-stop solutions for multivendor problems
Equipment manufacturers are trespassing on third-party maintenance territory.

48 What's good for National is good for the country
Brutalized by foreign competition, the U.S. semiconductor industry seeks government aid.

PAGE 56

MANAGEMENT

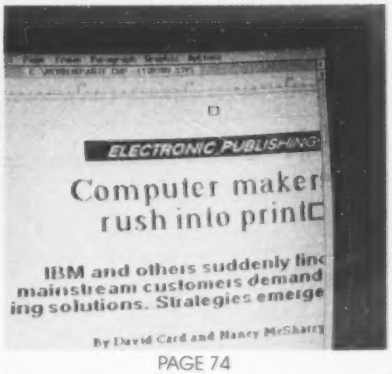
56 Tandem: Growth in a niche that never fails
James Treybig does not mind being called a niche player these days.

66 Dynatech profits by shying away from big markets
An amalgam of 40 companies, Dynatech steers clear of billion-dollar markets. Small can be beautiful.

PRODUCTIVITY

94 Westinghouse can be sure of its place in CIM history
Investing $45 million in an advanced manufacturing plant in Texas, the company expects big dividends.

106 IBM makes a statement at its Propriater plant
When Big Blue entered the PC printer market its goal was to design for "manufacturability." It succeeded.



PAGE 74

ELECTRONIC PUBLISHING

74 Computer makers rush into print
IBM and others suddenly find their mainstream customers demanding publishing solutions.

82 Case histories:

Teradyne: Where there's a will there's a way.

Apple: The big promoter isn't that big a user.

Texas Instruments: Semiconductor giant takes small steps.

ITT: Burned by one vendor, it sources from many.

General Electric: Bringing the good things to print pays off.

85 It's publish or perish
ELECTRONIC BUSINESS survey of big and small electronics companies using electronic publishing.

DEPARTMENTS

4 Inside Business

9 Update

17 Business Barometer: Offshore manufacturing and trade protection are depressing production.

112 Japan Report: Japan's new growth industry: America.

116 Comment: American high tech for sale — cheap.

118 Comment: GaAs: Management can no longer ignore it.

123 Comment: Service: A strategic weapon in electronics.

126 Plant Sites: Electronics on the French-German border.

128 Calendar

132 Editorial Index

134 Viewpoint

AN EDITORIAL INDEX OF ALL COMPANIES DISCUSSED IN THIS ISSUE CAN BE FOUND ON PAGE 132

Cover photo/Liane Enkelis

ELECTRONIC BUSINESS (ISSN 0163-6197) is published twenty-three times a year by Cahners Publishing, A Division of Reed Publishing USA, 275 Washington Street, Newton, MA 02158. William M. Platt, President; Terrence M. McDermott, Executive Vice President; Jerry D. Neth, Vice President of Publishing Operations; J.J. Walsh, Financial Vice President/Magazine Division; Thomas J. Dellamaria, Vice President Production & Manufacturing; Frank Sibley, Group Vice President. Copyright © 1987 by Reed Publishing USA, a division of Reed Holdings Inc.; Saul Goldwertz, Chairman; Ronald G. Segel, President and Chief Executive Officer; Robert L. Krakoff, Executive Vice President. Advertising and editorial offices: Cahners Building, 275 Washington Street, Newton, MA 02158. Telephone: (617) 964-3030. Circulation offices: 270 St. Paul Street, Denver, CO 80206. Telephone: (303) 388-4511. Mailing list rentals: (312) 299-9311. Second class postage paid at Denver, CO 80202 and additional mailing offices. Postmaster: Send address changes to ELECTRONIC BUSINESS, 270 St. Paul Street, Denver, CO 80206. ELECTRONIC BUSINESS is circulated to managers of electronics companies. Subscription rates: U.S., Canada and Mexico $50 per year; all other countries $85 per year (including air freight); $170 per year (air mail). Single copy rates: U.S. $6.00; Canada and Mexico $8.00; Foreign $10.00. Cahners Publishing Company • A Division of Reed Publishing USA • Specialized Business Magazines for Building & Construction • Electronics & Computers • Foodservice • Manufacturing • Book Publishing & Libraries • Medical/Health Care.

VBPA ABP

Offshore manufacturing, trade protection depress production

But last quarter's sales of computers and office equipment pointed up. Brazil gets a reprieve

Name a country where the market for computers and office equipment grew 35% in 1985 (a tough year), and which restricts imports of foreign-made equipment. No, it's not Japan (where local production last year grew in dollars but not in yen). It's Brazil. With its market protected from competition, this country's local production of computer equipment doubled between 1984 and 1986 while production in the United States barely grew 1% during the same period.

As Clayton Yeutter, the U.S. trade representative, demonstrated last Dec. 30 by imposing sanctions against European farm products, the United States is taking an increasingly critical view of — and more militant actions against — countries which restrict imports to protect their own production from competition while they enjoy free, sometimes even privileged, access to the U.S. market. In the case of the computer industry, production costs and prices are still cheaper in the U.S. than almost anywhere else except the Far East. Hit by the double impact of migration of production from these shores across the Pacific Ocean and the closure of markets such as Brazil, U.S. computer manufacturers produced fewer dollars worth of equipment in 1986 than in 1985. For the first time in history, the U.S. production of computers and office equipment (SIC 357) declined in 1986, by 3%, after a sluggish annual growth of 4% in 1985. Cahners Economics forecasts 4% growth for this year.

Along with the trade sanctions he issued against Europe, Yeutter also extended until June 30 a negotiation period, due to have expired at the end of 1986, with the Brazilian government regarding U.S. investment and software copyrights in that country. U.S. companies have complained that an unhelpful bureaucracy and unclear administrative rules hinder their investment in local manufacturing and the protection and sales of their software in Brazil. The Brazilian government, which had clarified somewhat other issues on computer imports, needed more time.

Not that the Brazilian market is that large. It only amounted to $2.3 billion for systems and $1.5 billion for software in 1985, about one-tenth the size of the U.S. market. But 1985 was also the year when domestic production of both hardware and software in Brazil edged out the value of imports (most of them of U.S. origin). Spurred by demand from the local market, the slight edge is expected to have turned last year into a gap, in Brazil's favor. And, with a population larger than Japan's, plus the access it has to most of its South American neighbors, Brazil is just too important a market for the U.S. government to ignore and too strategic a base for U.S. computer manufacturers to abandon.

As for the U.S. market, sales turned up a bit in the last quarter of 1986. National Advanced Systems, the computer division of National Semiconductor Corp., provided most of the gains that made its sales grow 30% over 1985's last quarter. NAS computers, however, did not contribute to the U.S. industrial production for SIC 357 because they are made by Hitachi in Japan.

ALBERTO SOCOLOVSKY

Computers and office equipment

Industrial production indexes, 1977 = 100

Historical data: Federal Reserve Board
Forecast: Cahners Economics

Electrical machinery

Manufacturers of electrical and electronic machinery operated at 71.4% of available capacity in the third quarter of 1986, up slightly from the 71.2% rate in the previous quarter. This was the first increase since summer 1984 and signaled that the industry finally has begun to pull out of its prolonged slump. Early reports for the fourth quarter show that operating levels continue to gradually improve. The uptrend is expected to be sustained throughout the current year, carried upward by a modest rebound in most nondefense segments of electronics. Factory operating rates are expected to reach 74% to 75% by the end of 1987 and 80% by late 1988.

Instruments

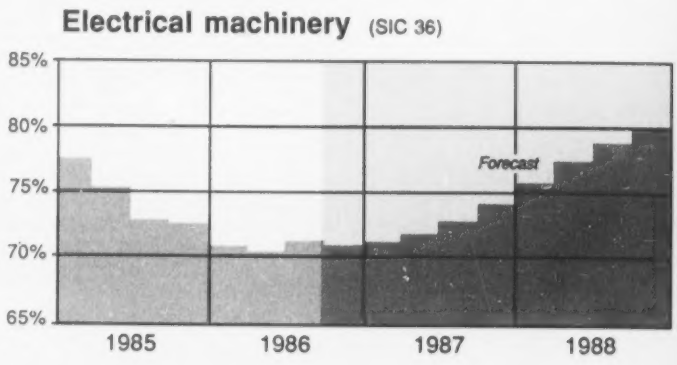
In the third quarter of 1986, instrument manufacturers utilized 80.1% of plant capacity, a very slight reduction from the second quarter's 80.5% rate. Not surprisingly, production volumes also decreased during the quarter (by about 0.1%). Manufacturers are likely to cut back further during early 1987, but a pickup in U.S. business investment should help to reverse the trend late this year. The operating rate, which should have finished 1986 at just under 79%, is expected to dip to about 77% by mid-1987 but should get back to 78% to 79% by year's end. An overall increase of about 5% is expected to follow over the course of 1988.

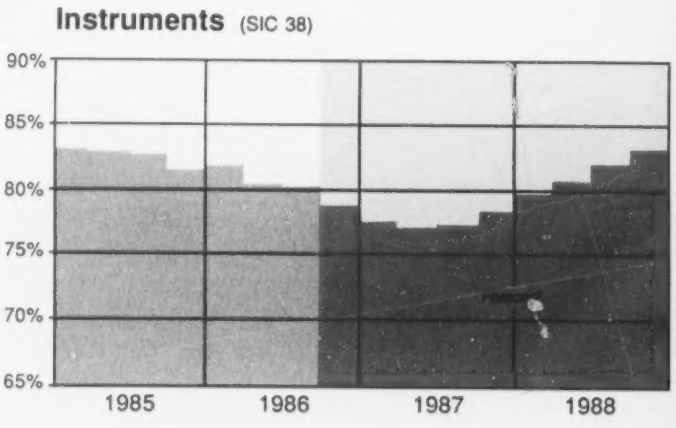
Aerospace

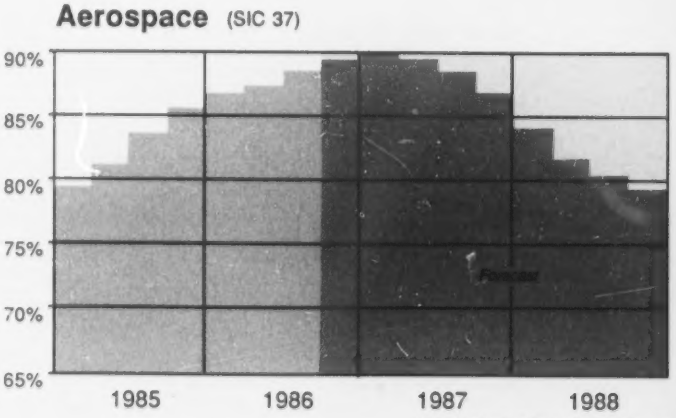
The rate of plant utilization in the aerospace equipment industries reached 88.3% in the third quarter of 1986, an increase of more than a full percentage point over the level in the second quarter. Year-end reports point to a fourth-quarter decrease of about the same magnitude. Although defense procurement authority has been squeezed by recent budget cutbacks, backlogs for military/aerospace equipment remain sufficiently high to sustain a healthy rate of production activity for at least another year. Plant operating rates are expected to level off at an 89% to 90% range through mid-1987, but will then begin to decline gradually. By the end of 1988, the rate should be down to nearly 80%.

Plant utilization

Average percentage of capacity utilized per quarter







Historical data: Federal Reserve Board
Forecast: Cahners Economics

Electronic components and accessories
Producer prices for electronic components rose 1.0% in the third quarter of 1986, their sharpest increase in 18 months. Price increases in product areas such as semiconductors and connectors were responsible for the jump. Most other types of components showed little evidence of upward pressure. Prices are expected to show another moderate uptick in the fourth quarter, bringing the yearly increase to 2%. This compares with a 2.4% rise in 1985. Accelerating market growth in 1987 and 1988 are expected to cause inflationary pressures to heat up once again. Prices should rise 3% this year and 3.4% in 1988.

Linear ICs
Third-quarter producer prices of linear integrated circuits (ICs) fell 0.8%, or at a 3.2% annualized rate of decline. This was the eighth consecutive quarter in which prices experienced downward pressures. After edging lower in the fourth quarter, prices are expected to firm or perhaps even rise slightly during 1987. This trend will stem from recent improvements in market conditions; orders jumped nearly 35% last year and shipments about 19% (several times faster than the growth rate for total U.S. market semiconductor shipments). Prices are expected to climb about 2% in 1987 and 3.7% more in 1988, just enough to counterbalance last year's 5.2% decrease.

Digital bipolar ICs
Producer prices for digital bipolar ICs were relatively stable during the third quarter of 1986, decreasing merely 0.7% compared with the prior quarter. This was only a brief pause in the price escalation which started in mid-1985. Preliminary estimates for the fourth quarter point to renewed upward pressures, with prices forecast to jump about 2.4%. For 1986 as a whole, prices will average 4.4% ahead of the previous year's level. If orders show the expected improvement in 1987, then inflationary pressures will continue to build. Prices are projected to increase 9.6% this year and about 6.5% in 1988.

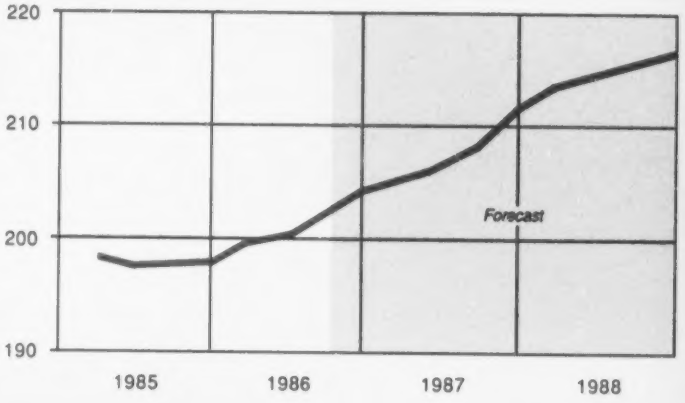
Digital MOS ICs
Prices of digital metal-oxide semiconductor (MOS) ICs tumbled 3% in last year's third quarter (an 11.3% annualized rate of decrease). This reversed the second quarter's equally strong move upward, bringing prices about back to first-quarter levels. Annually, prices are expected to post a decrease of more than 10% compared with 1985. U.S. market orders for the entire January to September period were more than double the year-earlier level, a brisk growth pace which suggests that prices could begin to escalate soon. Prices are currently expected to climb about 5.5% this year and 2.4% more next year.

Producer price indexes

Electronic components

December 1967 = 100, quarterly averages

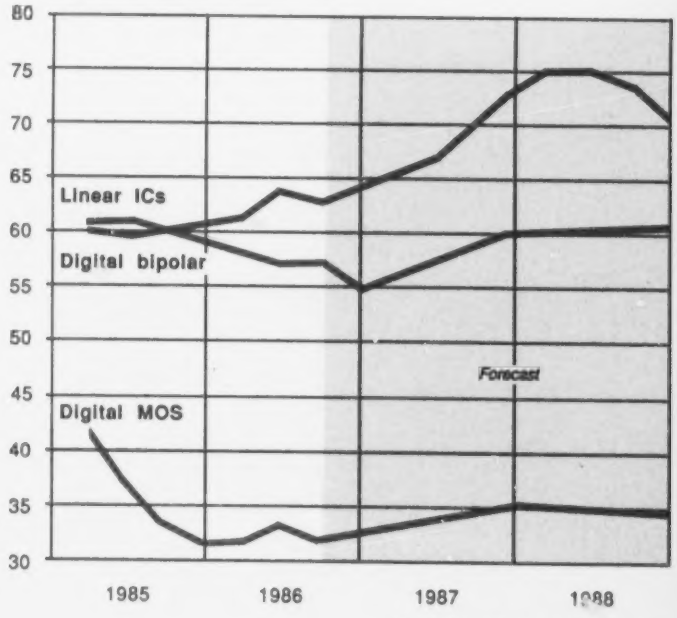
— **Electronic components and accessories** (SIC 1178)



Integrated circuits

December 1974 = 100, quarterly averages

— **Linear ICs** (SIC 1178-45)
— **Digital bipolar ICs** (SIC 1178-41)
— **Digital MOS ICs** (SIC 1178-24)



Historical data: Bureau of Labor Statistics
Forecast: Cahners Economics

Parallel processing: When computers swap information internally

Interest in parallel processing is running high. But so far it's only a $31 million market

Most computers today process data in a serial fashion, somewhat akin to a stream of cars heading one by one down a single-lane tunnel. In the future, however, most computers may be parallel processsors, machines designed to handle data concurrently — more like a multiple-lane tunnel with numerous off ramps.

But for the moment only two or three computer vendors are actually racing ahead with commercial parallel processor designs. The vast majority of companies are still keeping their parallel processor projects under wraps, hidden from view in private research and development (R&D) labs. The reason they are reluctant to enter the commercial market is simple, says Hambrecht & Quist Inc. analyst Jeffrey Canin: "There are too many contenders in the market. And there are lots more stumbling blocks in the way to developing clean parallel-processing [software] code."

"Many vendors are saying their machines offer parallel processing," adds Bruce Hadburg, a consultant with San Jose, California-based Electronic Trend Publications. Hadburg considers "true" parallel machines to be those which allow parallel execution of instructions within a single processor, permit parallel execution of instructions between multiple processors and/or link multiple processors (with or without shared memory). Based on this definition, the 1986 worldwide market for parallel processors reached approximately 47,300 units (19.9% of the total 237,894 high-performance processors shipped last year), worth $30.9 million, Hadburg says.

Interest in this new type of computer architecture by potential users is not at all surprising. With two closely related technologies — fault tolerance and multiprocessing — parallel processing makes for vastly increased computing speeds. But whereas fault-tolerant and multiprocessor machines work their magic by channeling different programs to different processors, parallel machines enable single programs to be partitioned among different processors.

But curiously, there is not a whole lot that is unique about the hardware itself used in parallel processing. In fact, most of the existing generation of machines are built around off-the-shelf microprocessors, such as the Intel Corp. 80X86, Motorola 68000 and the National Semiconductor 32032. Rather, parallel processing is largely the result of innovative, operating systems-level software, a large proportion of which is based on some derivative of Unix. And because many problems in mathematics, science and engineering are well suited to this type of partitioning, the first parallel processors have found solid acceptance in university R&D labs, among electrical and electronics companies, and in large-scale defense projects.

In the lab

Meanwhile, quite a few parallel-processing projects remain sequestered in the R&D labs of their manufacturers. IBM, for example, is known to have several ongoing parallel developments. Its most famous are the Yorktown Heights, N.Y., reduced instruction set computer (RISC) parallel machine which has received an enormous amount of press but may be years away from delivery; and its San Jose-based Amoeba project, consisting of several 43XX superminis linked together in a parallel configuration.

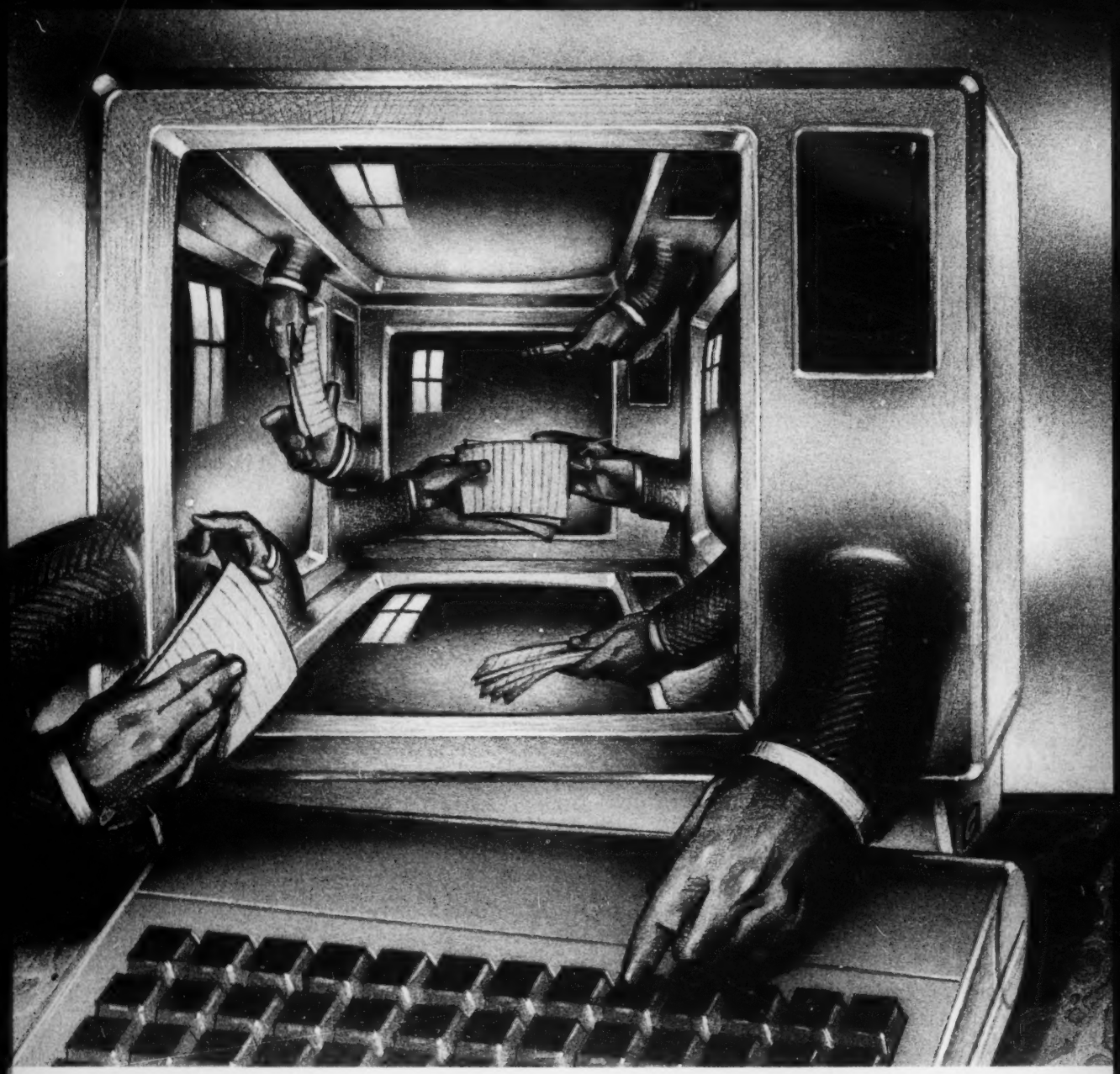
The emerging worldwide parallel-processing market

Processor type	Cumulative value ($ millions) 1986	1991	Percent value of parallel processors 1986	1991
Supercomputer	$3,866	$11,800	100.0%	96.0%
Minisupercomputers	390	1,750	100.0%	97.0%
Mainframes	140,000	205,000	13.8%	31.0%
Superminicomputers	23,400	37,700	10.3%	24.0%
Application-oriented processors	1,410	1,550	81.2%	82.0%
General-purpose workstations	960	1,930	4.3%	21.0%
Fault-tolerant computers	3,790	5,200	98.8%	94.0%
Total value for high-performance computing market	$173,816	$264,930	17.8%	34.7%

*Includes array processors, database machines and symbolic processors

Source: Electronic Trend Publications

Greg Couch



Greg Couch

At the same time, IBM's archrival, AT&T, has also made its first commercial move into parallel processing. Late last year, AT&T announced that it won a Defense Advanced Research Projects Agency (DARPA) contract in conjunction with New York City start-up Fifth Generation Computer Corp. for parallel computers that can recognize speech and images and handle other complex, pattern-matching tasks. The contract is expected to be worth $7.7 million to AT&T over the next three years.

Among the large uniprocessor manufacturers, Digital Equipment Corp. is considered to be the furthest along toward introducing a commercial parallel processor. Hambrecht & Quist's Canin says rumors are circulating that the Maynard, Mass., minicomputer maker could introduce a parallel machine within two years. "If any vendor has the credibility to make it big in this area, it's DEC," Canin claims.

For its part, DEC refuses to confirm or deny reports that at the end of 1986 it shelved two parallel research projects, one with Lawrence Livermore Labs, and another with Carnegie-Mellon University. (One, allegedly codenamed Parallel Processing Architecture, or PPA, was said to support 32 to 128 linked MicroVAX II nodes. The other, called Andromeda, reportedly bundled 64 MicroVAX IIs into a single cabinet.) Instead, a DEC spokesperson maintains that DEC's VAX 8300 and 8800 superminis can handle limited dual-processor parallel processing. And, since "all DEC's products are evolutionary, you can expect us to continue to do work in parallel processing," said the DEC source.

The parallel pack

Most big-name computer vendors, however, would be unable to introduce parallel versions of their lines (even if they existed) because they would obsolete most of their existing computers which still have three- to five-year life cycles ahead of them, industry watchers say. In addition, these companies could not afford to alienate their customers by rendering their proprietary applications software incompatible with the new, often Unix-based operating-system software required for parallel processors.

As a result, the top parallel-processing vendors tend to be single-product start-ups or relatively new supermini/

minisupercomputer makers. The recognized No. 1 vendor (in terms of installations to date) is Sequent Computer Systems Inc. of Beaverton, Ore., with more than 150 systems installed (although not all of these systems are used for parallel processing). Minisupercomputer vendor Alliant Computer of Littleton, Mass., with 55 installations as of the end of last year (when it filed its initial public offering), is No. 2.

Behind these two are several moderately successful vendors, including Culler Scientific, Intel Corp., N-Cube and Parallel Computers. The rest of the parallel pack is comprised of lots of small firms, each of which claims a handful of installations, and several more established vendors which are known to be having trouble finalizing, selling or maintaining their products. Among the latter are manufacturers like Aurora, Colorado's Denelcor Inc. — seen by many as the granddaddy of parallel processing — which filed under Chapter 11 bankruptcy protection in 1986; and minisuper maker Flexible Computer Corp. of Dallas, which was suffering from a severe cash flow problem at the end of last year.

What separates the sure-fire successes from not-so-sure ones (as well as from the outright failures)? "Some machines aren't suitable for anything but parallel processing," says Hambrecht & Quist's Canin. "I'm skeptical for their outlook — at least in the near term." Adds Electronic Trend's Hadburg: "Right now, almost everybody's going after the few same markets. That's where the action is."

The top parallel-processing vendors tend to be single-product start-ups or relatively new supermini/minisupercomputer makers

Traditionally, the biggest market for parallel processing has been the academic/scientific arena. Thinking Machines Corp., maker of the Connection Machine, had by year-end 1986 sold only six machines: one to DARPA, two to the Massachusetts Institute of Technology (MIT), one to Yale University and two to Perkin-Elmer Corp.'s MRJ government contracting subsidiary. (A typical Connection Machine consists of 16,000 processors and sells for $1 million.) But the start-up appears pleased with its progress. Even Thinking Machines director of marketing, James Bailey, emphasizes the company product's academic/scientific orientation and benefits, rather than any commercial ones. "The purpose of parallel processing is to gain efficiency and fit the problem better," he says.

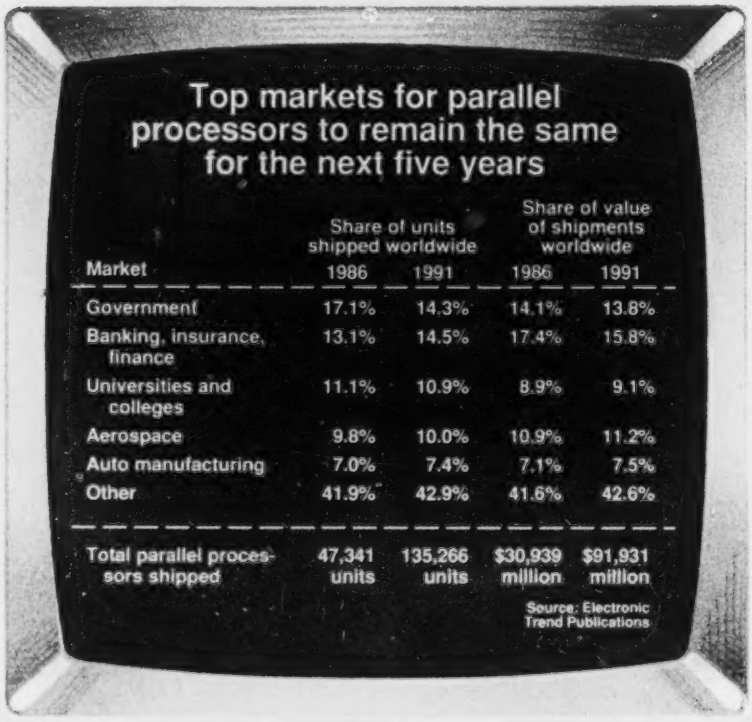
At the opposite end of the spectrum is Sequent, which already has signed up a handful of key original equipment manufacturers (OEMs), such as Siemens and Teradyne Inc. and more than 130 independent software vendors to help the company make inroads into the commercial world. In December, Sequent closed its third consecutive profitable quarter and ended the year at roughly $20 million, according to Michael Simon, vice president for marketing.

The company currently sells a compatible line of machines known as the Balance series, all of which are based on National Semiconductor's 32032. It is slated to debut a new parallel processor line — which may or may not be based on National's chips — sometime in early 1987. Market watchers such as Canin claim that relatively few of Sequent's machines are used for parallel processing. Canin says that most customers are buying the Sequent machine because it has better price/performance ratios than other superminis, notably DEC's VAX line. Not true, says Simon. He maintains that close to 90% of Sequent's machines are being used, at least part of the time, for parallel-processing applications.

"Our goal at Sequent is taking the [parallel-processing] technology beyond the scientific community," Simon says. "We are the first example of a truly parallel machine that's commercially focused."

Meanwhile the rest of the parallel processor community is searching for niches somewhere between the academic and the business worlds, hoping to avoid the shakeout so many industry watchers are predicting. But for at least the next five years, few, if any, new applications areas are expected to open up. Instead, says Hadburg, the growth markets for parallel machines will remain the same: banking, finance and insurance; government; universities and colleges; aerospace; and automobile manufacturing.

MARY JO FOLEY



Top markets for parallel processors to remain the same for the next five years

Market	Share of units shipped worldwide 1986	1991	Share of value of shipments worldwide 1986	1991
Government	17.1%	14.3%	14.1%	13.8%
Banking, insurance, finance	13.1%	14.5%	17.4%	15.8%
Universities and colleges	11.1%	10.9%	8.9%	9.1%
Aerospace	9.8%	10.0%	10.9%	11.2%
Auto manufacturing	7.0%	7.4%	7.1%	7.5%
Other	41.9%	42.9%	41.6%	42.6%
Total parallel processors shipped	47,341 units	135,266 units	$30,939 million	$91,931 million

Source: Electronic Trend Publications

One-stop solutions for multivendor problems

Equipment manufacturers are trespassing on independent service organizations' third-party maintenance territory

An increasing number of equipment manufacturers are being lured into the business of maintaining other vendors' equipment. The bait is the growing U.S. third-party maintenance market, a $1.56 billion U.S. industry that is expected to hit $3.26 billion in sales by 1991, according to Input, a market research firm in Mountain View, Calif.

Customer demand for "one-stop solutions" to problems caused by a multivendor environment is fueling the market.

At one multivendor location — Rockwell International Corp.'s avionics research and engineering division in Lakewood, Calif., — the decision to go with third-party maintenance was the result of a process of elimination, says Peter Kubischta, supervisor of Rockwell's software avionics integration lab. His unit uses equipment from 10 different vendors. Training and equipping an in-house maintenance staff "would be more expensive than going outside," Kubischta says. Another option: signing individual service contracts with each of the 10 equipment manufacturers, would not only be costly from an administrative standpoint, it would also lead to "finger-pointing" problems, he adds. In the end, Rockwell decided on a third-party maintenance solution and signed on with Harris Corp.'s Customer Support Division, based in Dallas.

> Manufacturers are expanding their service menus to include equipment from other vendors

Harris was attracted to third-party maintenance by both customer demand and revenue opportunities, says Carleton L. Smith, vice president of the company's Customer Support Division. "The price of hardware is dropping, how do you make more money?" asks Smith. One solution, he suggests, is to expand service offerings.

But, as the quality of hardware improves, many field service engineers are left in the position of "the old, lonely Maytag repairman, whom no one calls," says Rick Brusuelas, manager for the customer service program at Input. Hence, in order to get the most out of a nationwide team of field service engineers, manufacturers are expanding their service menus to include equipment from other vendors.

Trouble for ISOs

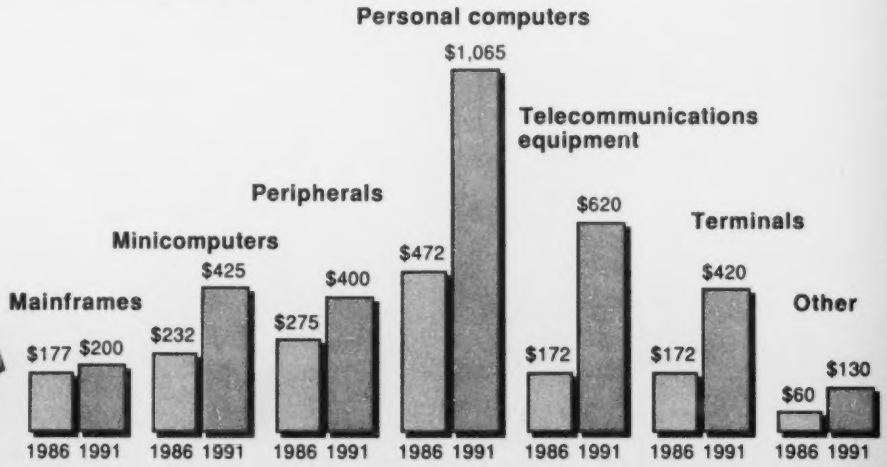
This trend will cause a slowdown for many of the traditional independent service organizations (ISOs), such as Bell Atlantic Corp.'s subsidiary Sorbus, TRW Inc. and Intelogic Trace. In the future, the ISO market revenue is forecast to grow at an average annual growth rate of only 8% — from $1.255 billion in 1985 to $1.85 billion in 1991, according to Richard C. Munn, president of The Ledgeway Group, Lexington, Mass., a research and consulting firm specializing in the service industry. Meanwhile, service by equipment makers is expected to grow at a much faster rate.

Munn divides the equipment makers' market into two segments. In the segment that Munn refers to as the "two and one-half party service" — where companies such as DEC and

Greg Couch

U.S. end-user expenditures for third-party maintenance services

($ millions)



IBM will service other vendors' equipment only in existing DEC or IBM environments — revenue is forecast to grow from $75 million in 1985 to $405 million by 1990, reflecting a 40% average annual growth rate. Munn separates two and one-half party service companies because, he says, there is a fundamental difference in providing additional service to an existing or already captive customer versus going outside that realm and building a new customer clientele based only on service. Within the major vendor segment — where equipment manufacturers such as Harris Corp., Honeywell Inc., NCR Corp., Sperry Corp. (now a part of Unisys Corp.) and Xerox Corp. offer third-party service at any site — revenue is forecast to grow from $150 million in 1985 to $300 million by 1990, reflecting an average annual rate of 15%, according to Munn.

Leading the pack in two and one-half party service is Digital Equipment Corp., which has been offering its DECompatible service since 1983. Today, on a region by region basis, DEC services some 500 non-DEC products. However, "the whole purpose [in servicing non-DEC equipment] is customer satisfaction. Revenue is not the driving force," insists Daniel Loesel, business manager at DEC's U.S. headquarters for vendor equipment services in Westborough, Mass. Loesel estimates that revenue from servicing non-DEC equipment represents less than 10% of all of DEC's service revenue. In the last fiscal year, ended June 30, service accounted for about a quarter of the company's total $7.5 billion in sales, according to analysts' estimates.

Even Big Blue, which traditionally limited its service exclusively to IBM equipment, is starting to service non-IBM equipment, albeit on a very limited basis. Over the past year, the Armonk, N.Y., giant has begun to service a list of more than 80 peripherals — such as modems, printers and plug-in cards — that are attached to IBM PCs.

Even Big Blue, which traditionally limited its service to IBM equipment, is starting to service non-IBM equipment, albeit on a very limited basis

For those manufacturers daring to venture outside their own customer base, however, taking the plunge to service other vendors' equipment is far more complex than most entrants realize, says William J. Herbert, president of consulting firm Coordinated Service Inc., in Littleton, Mass. "Just because you have a couple of thousand talented service people spread across the country who understand your own equipment, that doesn't guarantee success [in third-party maintenance]," says Herbert.

In order to increase one's chances of success, Rebecca Segal, analyst at research firm International Data Corp. in Framingham, Mass., advises equipment makers to "stick to what you know, or find a niche that's profitable."

Taking the plunge

In fact, when Harris first took on third-party maintenance in September of 1985, the business plan called for a focus on specific products. Since that time, however, "we have come to realize that you have to look at particular segments where you can offer something special, as opposed to trying to be everything to everyone," says Smith. Now, Harris is concentrating on several niche markets, including aerospace manufacturers and small government operations such as county municipalities — two customer segments that tend to have a vast mix of suppliers, Smith notes. Another area Harris is working on involves signing service agreements with a number of Japanese original equipment manufacturers (OEMs), which, according to Smith, "have good products and good sales, but are not noted for their service." Out of the $75 million generated by Harris' Customer Support Division last year, $3 million came from third-party service, and Smith expects the third-party revenue to double this year.

One vertical area arousing a lot of interest these days is telecommunications equipment, says Brusuelas of Input, "mainly because the [telecommunications equipment] manufacturers themselves are not responding." Service revenue for telecommunications equipment is expected to reach $620 million by 1991, reflecting a 29% average annual growth rate, according to a recent Input report. Other product segments that promise healthy growth rates for service revenue include: the terminals segment, which is forecast to grow from $172 million in 1986 to $420 million by 1991; personal computers, which will grow from $472 million to $1.065 billion; and minicomputers, which is expected to grow from $232 million to $425 million.

The biggest opportunity in the future could be the servicing of software. The "next big stepping stone," says Segal of IDC, will be in software support. Software is becoming increasingly intertwined with hardware, she points out, yet software support frequently requires a whole different set of skills. As a result, Segal says, it is difficult for third-party maintenance vendors to attract and hold the right people to provide such service.

Other areas of potential growth within the service industry, include: assisting customers with product selection; consulting with customers as they plan their networks; and providing educational services such as training. In the segment for large systems — mainframes and supercomputers — where service revenue is expected to grow from $4.1 billion in 1986 to $5.8 billion by 1991, the hardware share of revenue will decrease from 81% to 63%, while software revenue will grow from 11% to 23%. The remainder of 1991 revenue will come from professional services such as consulting and planning, at 10%, and education and training, at 4%, according to Input.

CAROL SUBY

Tandem: Growth in a niche that never fails

James Treybig does not mind being called a niche player these days. His strategy has reaped nearly $1 billion

By Anne Knowles

Being traditionally thought of as a niche market player isn't the worst thing in the world — especially when your niche protects you from the market giants while widening at a strong rate. Tandem Computers Inc., the Cupertino, Calif., maker of fault tolerant computers — systems designed to fail rarely, if ever — has continued to enjoy a protected niche status throughout the computer industry's upturns and downturns. The company's unique systems design, based on multiple processors and a proprietary operating system, sets the 10-year-old company apart, pegging it as a supplier to the relatively small fault tolerant market. But Tandem's success has caused it to start looking beyond its safe haven and has caused other companies to covet Tandem's business.

Consider Tandem and the business it is in. Larger computer manufacturers have shied away from the fault tolerant market, in part, because of the inherent difficulties of designing fail-proof architectures. Meanwhile, Tandem has emerged from a near thorough shakeout in the fault tolerant market, in the process rising to the top of the heap and capturing over 80% market share. Most important, the reliability provided by such systems has become increasingly attractive to more customers in markets outside fault tolerance. Add that up and you have a $768 million company for the fiscal year ending Sept. 30, 1986, and a firm now considered a major force in the computer industry. Says Kimball Brown, an industry analyst with Dataquest Inc., a market research firm in San Jose, Calif.: "The three companies that are the biggest threat to IBM are Digital Equipment Corp., NEC Corp. and Tandem."

No small praise for a niche market player. In fact, says James G. Treybig, Tandem's president and chief executive, he no longer minds Tandem being tagged a niche player. "I used to not like that word, niche," says Treybig. "But I don't think it's negative. We're choosing niches. By choosing where we fight and win we can be quite a big, profitable company."

Today Tandem is trying to do all of those things. And the company's so-called niches are more numerous now than they have ever been. Tandem is targeting vertical markets — from transportation to retail point-of-sales — that fall under a larger market umbrella called on-line transaction processing (OLTP). While traditional fault tolerant applications — those applications where system failure can be disastrous — represented only a $738 million market in 1985, OLTP — defined as the execution of transactions in real time — reached an estimated $20.3 billion last year, according to Dataquest. By 1990, projects Dataquest, OLTP will be a $35 billion business, accounting for about 70% of all new computer sales.

Because of this, larger computer makers are finding the OLTP market too alluring to ignore. And, as Treybig says, Tandem is fighting. IBM already has about 54% of the OLTP market because of its preeminent position in the mainframe market. (Most OLTP applications are supported by a host computer, which, as a general rule, is a mainframe containing a database. A front-end processor provides fault tolerance, safeguarding data in case any

AT A GLANCE

Tandem Computers Inc.
Cupertino, Calif.

	FISCAL YEAR COMPARISON		
	1985	1986	Change
Sales ($ thousands)	$624,138	$767,793	+23.0%
Net income ($ thousands)	$34,374	$63,766	+85.5%
Net income/sales	5.5%	8.3%	–
Cost of sales/sales	38.5%	32.3%	–
R&D/sales	11.5%	11.3%	–
Marketing, G&A/sales	42.0%	42.6%	–
Capital expenditures/sales	10.8%	8.5%	–
Number of employees	5,494	5,719	+4.1%
Sales per employee	$113,604	$134,253	+18.2%
Net income per employee	$6,257	$11,150	+78.2%
Current ratio	4.44	3.87	–
Debt/equity ratio	0.01	0.01	–

Fiscal year ending September 30.

Source: Dow Jones News/Retrieval

HEEEEEEERE's JIMMY: Tandem president James Treybig regularly takes to the in-house company network to discuss strategy

Liane Enkelis

other part of the system fails. At the end of the network, depending upon the application, are various kinds of terminals, such as personal computers or cash registers, which can access or alter the database in real time.)

But, says George Weiss, an analyst with Gartner Group Inc., in Stamford, Conn., "OLTP is moving toward distributed processing and departmental systems, away from mainframes." Because of that, IBM has fortified its OLTP offering through an original equipment manufacturer (OEM) agreement with Stratus Computer Corp., of Marlboro, Mass., for a low-end fault tolerant system that IBM calls the System/88. And Stratus, bolstered by IBM's stamp of approval, and despite the fact it is one-sixth the size of Tandem, has proven to be the most viable fault tolerant alternative to Tandem. In particular, Stratus' strengths — low-end systems and the East Coast sales territory — have been Tandem's weaknesses.

In more specific markets Tandem is treading on the toes of other major manufacturers. In retail, which currently represents 5% of Tandem's revenue, NCR Corp. has been the historical favorite due to its point-of-sale terminals. In April, NCR shored up its product line with the announcement of its 9800 series mainframes incorporating fault tolerant features.

Digital Equipment is expected to announce enhancements to VMS, its operating system, that will make the company a more competitive threat in OLTP. But DEC's systems, says the Gartner Group's Weiss, are not optimized for OLTP applications. "DEC has a long road on this one," says Weiss. Despite that, DEC dominates manufacturing, a market that accounted for 21% of Tandem's 1986 sales. Concludes Treybig: "In all the industries where there are engineers we have DEC. And in all the industries where there aren't engineers we have IBM."

According to Treybig, however, Tandem is winning in those markets that it is zeroing in on. Tandem equipment is used in 19 stock exchanges. In telephony, where Treybig says Tandem is safer because of the lack of IBM penetration, the company supplies processors to Pacific Bell, Southwestern Bell and US Sprint. Tandem computers automate manufacturing at Apple Computer, Audi and Hughes Aircraft Co.

"In point-of-sale, we have literally every major bank. We have big retailers like Target and [J.C.] Penney. We have people in the supermarket area like Safeway and Kentucky Fried Chicken. We have every major petroleum company in the U.S., except one. And that one is a Penney's customer, and Penney is a Tandem customer. That's a niche," says Treybig. "And we won it all."

Low-end lure

Tandem hasn't won it all yet. But the company is systematically addressing gaps in both its marketing and product line that have hindered it

before. Treybig is the first to admit the mistakes made in the past. "We didn't do a good job on third parties. We didn't build products in the lower price range and that was a strategic mistake. We didn't do a good job, for example, on major account support. Five years ago we were lucky to sell a customer one system," says Treybig.

The remedy, says Treybig, is to concentrate on sets of solutions rather than individual products. "I think the importance of solutions is that the customer buys one and then they can buy a second one much sooner. And a third and a fourth," says Treybig. And each time, adds Treybig, it becomes, "easier to convince them to buy it."

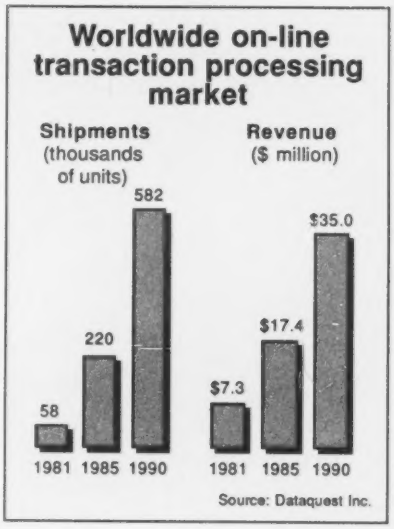
To soldify its solution sell, Tandem is broadening its product line. Already, says Gartner Group's Weiss, "Tandem has the strength at the high-end." Tandem's TXP, with an average selling price of $450,000, accounts for approximately 75% of the company's revenue. Tandem's VLX, announced last April, has a processing range of 40 to 160 transactions per second (TPS), a price tag starting at $1 million and currently represents about 20% of the company's revenue. It is also the first Tandem system that encroaches on IBM's mainframe turf. Another high-end processor, code-named Cyclone, which analysts project will be 50% faster than the VLX, is expected next year.

In the midrange, Tandem rejuvenated its product line with the EXT-10 and EXT-25, announced last August. Says Treybig: "Our success this year is going to come from the VLX, EXT-10 and EXT-25." But from a new product point of view, Treybig says, 1987 will focus on the low-end.

Treybig says that the announcements will involve entry-level systems, application generators and database software. Specifically, most industry analysts believe Tandem will announce three low-end systems designed to compete more effectively, on a price basis, with DEC, Stratus and other rivals. By midyear, Tandem should unveil its first system based on complementary metal-oxide semiconductor (CMOS) technology. Jonathan Fram, an analyst with Bear, Sterns & Company Inc. in New York City, contends the system may also be Tandem's first uniprocessor configuration. A single processor computer, says Fram, would not be capable of fault tolerance but would act as a node on a network.

Tandem will also announce its second computer which will run a standard operating system. Already the company sells PC AT-compatible machines, which it buys from Tandon Corp. that run MS-DOS. The company is buying Altos Computer Systems' 3068 machine, based on Motorola Inc.'s 68020, 32-bit chip and the Unix operating system. Industry observers disagree over whether the machine will contain single or multiple processors. But these observers believe the system is designed to enable Tandem to bid on contracts which require Unix.

Asked if the company will ever offer Unix on a proprietary Tandem computer, Treybig says, "We're going to offer more than the Altos." Asked if offering Unix, a standard system offered by many vendors, could turn Tandem hardware into a mere commodity, Treybig contends, "The reason people like Unix is the perceived ease of programming. But application



Lisne Erkala

MICHAEL BATEMAN, vice president for third-party marketing and **GERALD PETERSON,** vice president for marketing, manage Tandem's thrust into the OEM and VAR market

generators are going to replace that. When that point gets here you don't care that the underlying hardware is microprocessor based running Unix or whether its gate arrays running our operating system."

Tandem's hardware design, today, uses multiple processors with their own memory. Because of that, the systems are easily expandable. Additional processors can be added onto a system without the performance degradation created when more processors try to access the same memory.

Tandem's proprietary operating system, Guardian, manages the flow of data between the processors' memories. It is a message-based system. The importance of this is that if processor A, for example, needs data located at processor B's memory, the system will send a message requesting that the information be transferred to processor A. To users on a network, says Fram, all data looks local. The net result, says Dataquest's Brown, is the only truly distributed processing system on the market.

In addition, Tandem's Multilan product, announced last November, enables users to connect to any local area network (LAN) supported by IBM's Network Basic Input/Output System (NETBIOS). "Tandem's made great strides in LAN interfaces," says Tony Fernandez, a staff manager with Pacific Bell. Pacific Bell uses Tandem's NonStop II and TXP systems and Tandem's Expand networking software.

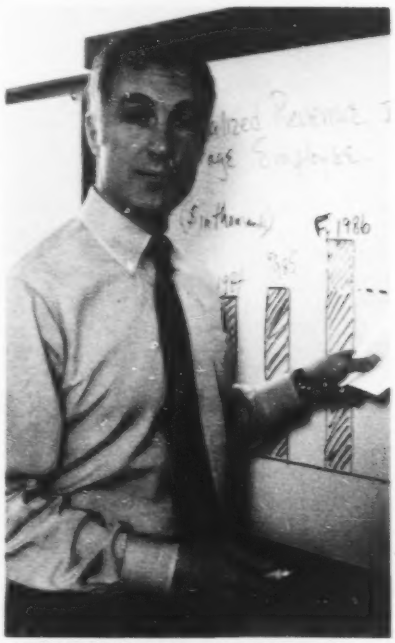
But he is dissatisfied with Tandem's datacommunications products and, recently, with the company's software support. "We're not getting any," says Fernandez. He would also like to beta test Tandem's Teseract product, the company's as yet unannounced database system. But Tandem, says Fernandez, wants Pacific Bell to buy a VLX to do the testing on. "It's power politics," says Fernandez. "We've always had a very good relationship;" but, he says he is now having problems with Tandem that he hasn't had in the three years since Pacific Bell first purchased its Tandem system. "That happens with change," Fernandez says.

Competitive alliances

Things are changing at Tandem. In the past, Tandem has depended primarily on direct sales to price-insensitive *Fortune* 1000 customers. Today, OEMs and value-added resellers (VARs) still only represent 7% of Tandem's sales. But with the thrust into the low-end, Tandem marketing is changing its look.

The process began with a reorganization of the company's third-party marketing division in October 1985. Today, it is called the Alliance program. Under this umbrella falls all of Tandem's OEMs, software developers and VARs. This program is managed by Michael K. Bateman, vice president for third-party marketing.

The Alliance program is broken into five categories. Solution implementers, says Bateman, include consultants like Arthur Young & Co. which will install computer-integrated manufacturing (CIM) turnkey systems for Tandem customers. Tandem writes its own systems software, such as Encompass, the company's database product; and independent software vendors (ISVs) develop programming tools for Tandem systems. Tandem makes the sale, says Bateman, and splits the revenue with the ISV.



DAVID RYNNE, Tandem's chief financial officer: "We restored our margins to very acceptable levels in 1986"

Tandem has had considerable success signing up software houses which write application packages. The company's list of third-party software writers has grown from 35 in 1983 to 250 today. Bateman estimates that one-half to two-thirds of Tandem's new customers are influenced by a third party.

Two third-party software houses, under the direction of Susan L. Hailey, Tandem's retail industry manager, clinched the deal on Ross Stores, according to Gerald L. Peterson, Tandem's vice president for marketing. Signorum Inc., Fremont, Calif., and LeRoux, Pitts & Associates Inc., Clearwater, Fla., jointly developed StoreLink, a fault tolerant retail point-of-sale control system. Ross Stores was able to tie together sales and inventory at 146 stores, each with an average of 10 NCR cash registers, using the software. In the process, Ross replaced six NCR minicomputers, used at night as batch processors, with a Tandem TXP. "NCR didn't have a solution," says Peter Hart, vice president for information systems with Ross. "We needed a vendor to provide a single solution."

Tandem has about 10 classical OEM relationships. System Integrators Inc. in Sacramento, Calif., is Tandem's largest OEM. SI sells turnkey publishing systems, built around all of Tandem's processors except the VLX, to such customers as *The Washington Post*, *The Los Angeles Times* and *The Chicago Tribune*. According to Stephen Nilan, SI's director of marketing, Tandem systems were chosen because of their modular expandability, reliabilty and communications capabilities. (SI uses Tandem's networking software called Expand.) Even though DEC products were evaluated by SI, Nilan says that the company didn't want, "just another me-too product."

But SI has had its problem with Tandem. The VAR would like to expand its customer base to smaller publishers and is looking forward to low-end products Tandem is expected to announce this year. "We've had a problem moving downward," says Nilan. "And our margins are being squeezed." In addition, says Nilan, SI thinks the price of the TXP, which hasn't been cut since the introduction of Tandem's high-end VLX, should better reflect market conditions. But, adds Nilan, "we're so far down the road with Tandem we can't think of changing."

Tandem is hoping the same isn't true of DEC's VARs. The company's most recent, and industrious, project under Alliance has been the courting of VARs that are dissatisfied with DEC's discount schedules. In September of last year, Tandem contacted over 1,100 DEC VARs. A telemarketing campaign was carried out by a consultant in October and a teleconference was broadcast to 26 cities. Treybig does not expect to see con-

Liane Enkelis

crete results from the program until mid-1987. But he says he would be content with three or four VARs on the East Coast — where DEC has a stronghold and Tandem has a hole. According to Philip A. Stack, regional Alliance program manager for the Northeast, the company was at the contract stage with that many eastern VARs in December.

Cutting costs

Through all this change, Tandem has certainly been profitable. In Tandem's latest fiscal year, ended Sept. 30, revenue rose 23% while net income climbed 86%, to $63.8 million. Tandem's operating margins, at 13.8%, are the highest they have been in five years. Operating income spiraled 112%, to $105.9 million. Tandem's pretax profit margins stood at 13.8%, better than industry wunderkind DEC. And net income as a percent of sales jumped to 8.3% from 5.5% in 1985.

But, it has been a few years since Tandem's income statement looked so good. In the early 1980s, the company was predicting it would be a billion-dollar company by mid-decade. At the time, Tandem had the growth rates to substantiate such claims. In 1980, Tandem raised its net income 117% on a revenue increase of 95%. The following year revenue rose 91% and net income soared 148%. But, by 1984, an economic snafu hit the industry and Tandem's revenue growth slowed to a respectable 17%. But net income plunged 20%.

"We built expenses faster than we should have, given the decrease in growth rates," explains Treybig. In response, like many other computer manufacturers, Tandem implemented cost cutting measures that started in manufacturing and led to stiffer personnel policies, including short-term hiring and salary freezes.

About three years ago, says David J. Rynne, Tandem's chief financial officer, the company put in place various "nuts and bolts" improvements to expedite the production process. Included was a revamping of manufacturing protocols that cut back on overtime. During the slower first two months of a quarter, says Rynne, manufacturing prebuilds subassemblies needed for the hectic last month of the period. Stricter quality-control procedures were imposed on suppliers. In the end, says Rynne, reducing the cost of production resulted in a drop in the cost of inventory.

"But manufacturing is only half the story as it appears on the P&L [profit and loss]," statement, says Rynne. The other half, says Rynne, is savings from newer technologies incorporated in newer Tandem products. Tandem's VLX, for example, is based on very large scale integration (VLSI) chips developed jointly between Tandem and Motorola Inc. In addition, the MCA2800 ALS, the processor designed by the two companies, has now become a standard product offering at Motorola, which has additionally reduced the cost and guaranteed volume production for Tandem.

Tandem's VLX is based on VLSI chips developed between Tandem and Motorola

Bear Sterns' Fram believes the VLX has a preexisting upgrade built into the first model. The VLX, which uses both emitter coupled logic (ECL) and transistor-transistor logic (TTL), has the same 83 nanosecond clock cycle as Tandem's previous high-end offering, the TXP. What Fram and other analysts expect is a complete ECL implementation of the VLX — which will use the same chassis, have better performance and a higher price tag, and all without increasing Tandem's manufacturing costs.

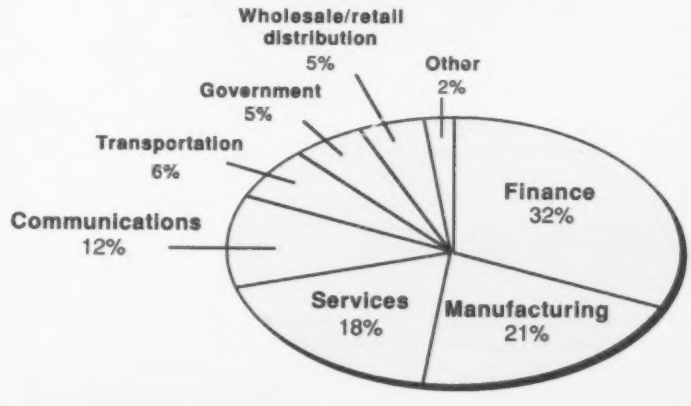
The end result, for Tandem, has been an improvement of gross profit margins, from 61.5% in 1985 to 67.7% in 1986. But those benefits will be flattening out this year and, in fact, says Treybig, Tandem has to raise its inventory level above the $64 million recorded at year end. "We restored our margins to very acceptable levels in 1986," says Rynne. "We don't aspire to improve them."

But this year Tandem is changing its accounting practices in regard to selling, general, and administrative (SG&A) costs because of an order from the Securities Exchange Commission. The result will be a slight drop in both gross profit margins and SG&A expenses. SG&A costs, at 42.6% of sales, have always been above the norm due to the customer hand-holding needed to sell Tandem systems and because of the high cost of competing against IBM.

Tandem's 1986 balance sheet was equally impressive. The company ended the year with virtually no long-term debt — $4.5 million — and a lot of cash — $239.8 million. According to Rynne, Tandem hopes to buy five or six buildings it now leases in Cupertino. In addition, the company may make investments in, or acquisitions of, companies developing technology that is pertinent to Tandem's business. Already Tandem has equity investments in numerous companies. With Pacific Bell, Tandem has a 24.5% stake in Integrated Technology Inc. of Plano, Texas, for telecommunications network systems. And in March, Tandem invested in Triplex, a maker of fault tolerant programmable logic controllers.

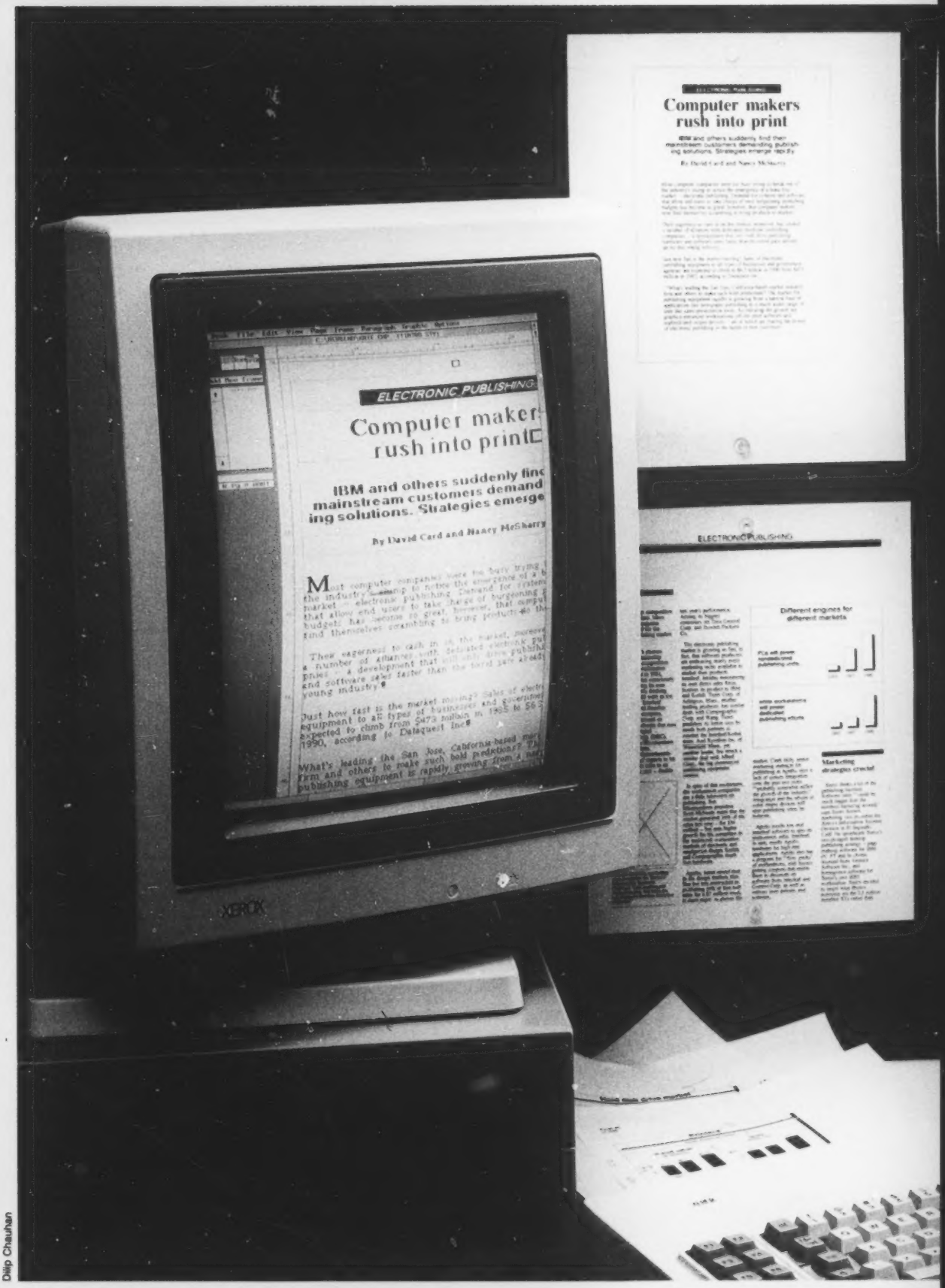
And finally, says Rynne, Tandem can use the money to finance further growth. □

Tandem's fiscal 1986 revenue by market segment



*Percentages do not add up to 100% due to rounding

Source: Tandem Computers Inc.



Dilip Chauhan

ELECTRONIC PUBLISHING

Computer makers rush into print

IBM and others suddenly find their mainstream customers demanding publishing solutions. Strategies emerge rapidly

By Nancy McSharry

Most computer companies were too busy trying to break out of the industry's slump to notice the emergence of a bona fide market — electronic publishing. Demand for systems and software that allow end users to take charge of their burgeoning publishing budgets has become so great, however, that computer makers now find themselves scrambling to bring products to market.

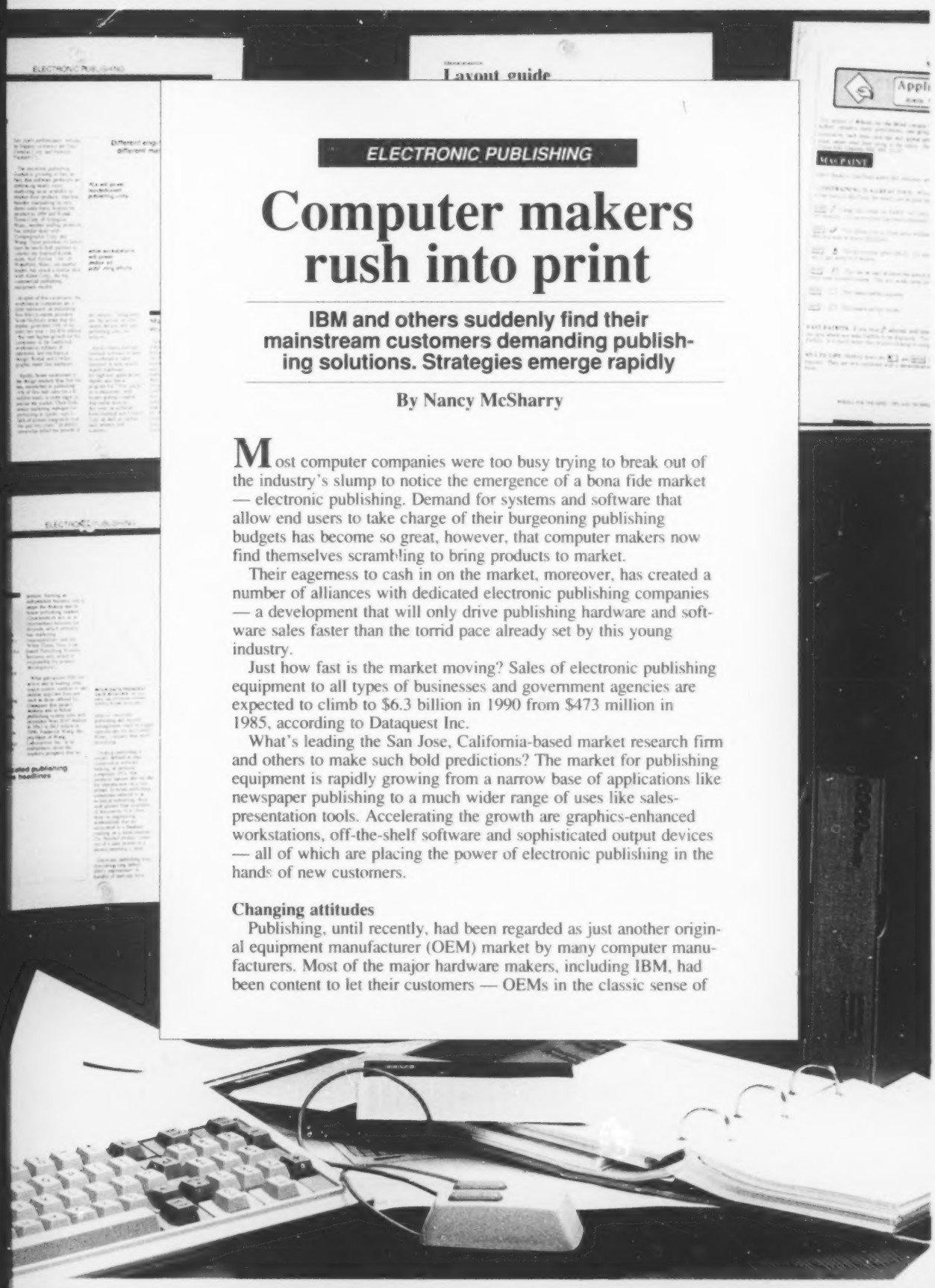
Their eagerness to cash in on the market, moreover, has created a number of alliances with dedicated electronic publishing companies — a development that will only drive publishing hardware and software sales faster than the torrid pace already set by this young industry.

Just how fast is the market moving? Sales of electronic publishing equipment to all types of businesses and government agencies are expected to climb to $6.3 billion in 1990 from $473 million in 1985, according to Dataquest Inc.

What's leading the San Jose, California-based market research firm and others to make such bold predictions? The market for publishing equipment is rapidly growing from a narrow base of applications like newspaper publishing to a much wider range of uses like sales-presentation tools. Accelerating the growth are graphics-enhanced workstations, off-the-shelf software and sophisticated output devices — all of which are placing the power of electronic publishing in the hands of new customers.

Changing attitudes

Publishing, until recently, had been regarded as just another original equipment manufacturer (OEM) market by many computer manufacturers. Most of the major hardware makers, including IBM, had been content to let their customers — OEMs in the classic sense of



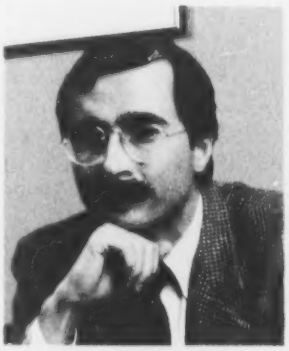
the term — develop the software and add the peripherals needed to sell publishing systems. They let their OEM customers — the hardcore print suppliers like Allied-Signal Inc.'s Linotype division, Compugraphic Corp. and Eastman Kodak Co.'s Atex division — worry about point sizes and the like. After all, the market for commercial printing systems, typesetters and electronic service bureaus was only projected to reach $700 million by 1990.

"IBM has not moved aggressively in the last decade" in directly pursuing publishing, acknowledges Merry Quackenbush, director of IBM's Valhalla, New York-based Media Industry and Publishing Systems Division, which is part of Big Blue's Information Systems Group. The company last summer took a more aggressive posture, forming an independent business unit to target the desktop and in-house publishing markets. (Quackenbush acts as an intermediary between her division, which primarily has marketing responsibilities, and the White Plains, New York-based Publishing Systems business unit, which is responsible for product development.)

What galvanized IBM into action and is leading other major system vendors to take similar steps are forecasts such as those offered by Dataquest that project desktop and in-house publishing system sales will skyrocket from $147 million in 1985 to $4.9 billion in 1990. Frederick Wang, the president of Wang Laboratories Inc., is so enthusiastic about the market's prospects that he believes electronic publishing and records management could be bigger opportunities for his Lowell, Mass., company than word processing.

Desktop publishing is usually defined as page composition software running on personal computers (PCs) that produces memos and the like for reproduction on a laser printer. In-house publishing, sometimes referred to as technical publishing, deals with greater final quantities of documents. It is often done on engineering workstations that are networked to a database residing on a minicomputer. The finished product comes out of a laser printer or a phototypesetting system.

Electronic publishing was flourishing long before IBM's *imprimatur*. A handful of start-ups have written publishing software for workstations to go after the in-plant and technical publishing market. And Apple Computer Inc. has reaped the fruits of other software start-ups' labor in the desktop arena. Now the new guys are cutting deals with the commercial publishing equipment vendors, as Kodak and Xerox Corp. have started selling systems from their base in printers and photocopiers.



INTERLEAF'S PRESIDENT DAVE BOUCHER: His company has consciously avoided building its own computers

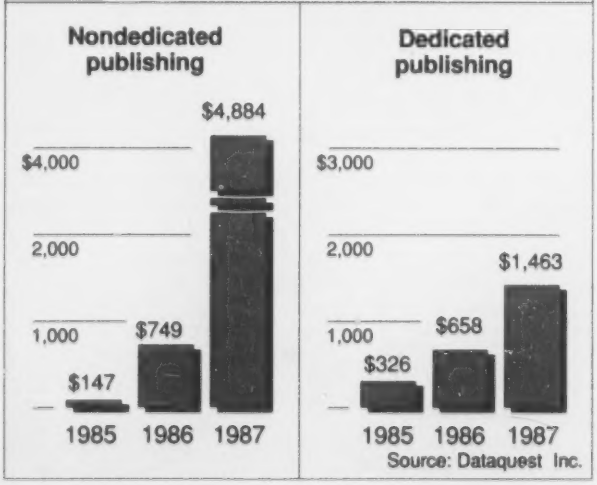
Demand for chips

The opportunities in electronic publishing are not limited to major systems vendors and software houses. Semiconductor producers, board makers, peripheral suppliers and workstation manufacturers also stand to benefit from the market's growth. As the gap between personal computers and workstations steadily closes, more powerful chips are needed to accommodate the sometimes large amounts of memory required to run a piece of sophisticated text and graphics software.

Hardware — particularly peripherals such as monitors, scanners and laser printers — must adapt to the needs of the electronic publishing market. For example, Dataquest expects the scanner market for PC-based publishing systems to explode from 2,000 units sold in 1985 to 670,000 units in 1990. Workstation sales, meanwhile, are being driven by the dramatic increase in page composition software programs. More

The opportunities in electronic publishing are not limited to major systems vendors and software houses

Nondedicated publishing grabs headlines



Source: Dataquest Inc.

than 40 such programs were developed for the electronic publishing market in 1986.

Interleaf Inc.'s success typifies the relationship between page-composition software and workstation sales. Founded in 1981, the company has consciously avoided building its own computers. "No thinking customer would want us for that purpose," Interleaf president David Boucher explains. His company, instead, has focused on developing software that runs on Apollo Computer Inc., Digital Equipment Corp. (DEC), IBM and Sun Microsystems Inc. workstations. Cambridge, Massachusetts-based Interleaf expects to hit $35 million in sales in its current fiscal year — double last year's performance. Among its biggest customers are Data General Corp. and Hewlett-Packard Co.

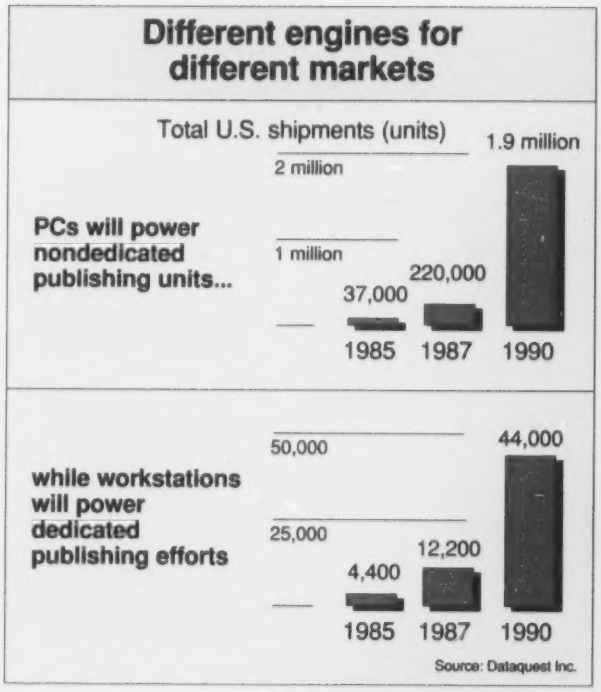
The electronic publishing market is growing so fast, in fact, that software producers are embracing nearly every marketing tactic available to leaf, besides maintaining its own direct salesforce, licenses its product to IBM and Kodak. Texet Corp. of Arlington, Mass., another leading producer, has similar deals with Compugraphic Corp. and Wang. Texet president Al Ireton says he needs both partners to counter the Interleaf/Kodak team. And Xyvision Inc. of Wakefield, Mass., yet another leader, has struck a similar deal with Allied-Signal, the big commercial publishing equipment vendor.

In spite of this excitement, the workstation companies are a little lukewarm on publishing. Sun Microsystems president Scott McNealy notes that the market generated 16% of his sales last year — for $34 million — but sees higher growth for his computers in the traditional workstation markets of electronic and mechanical design. Kodak and Compugraphic resell Sun hardware.

Apollo, better established in the design markets than publishing (4% of first-half sales for a $7 million total), is more eager to pursue the market. Clark Hills, senior marketing manager for publishing at Apollo, says a lack of system integration over the past two years "probably somewhat stifled the growth of the industry." Integration and the advent of color output devices will spur publishing sales, he believes.

Apollo resells low-end Interleaf software to spur its workstation sales. Interleaf, in turn, resells Apollo hardware for high-end applications. Apollo also has a program for "five-packs" of workstations, with buyers getting coupons that entitle them to discounts on software from Interleaf and Context Corp. as well as various laser printers and scanners.

Clark Hills, senior marketing manager for publishing at Apollo: System integration and the advent of color output devices will spur sales



Marketing strategies are crucial

Xerox thinks a lot of the publishing business. Software sales "could be much bigger than the numbers bantering around," says James Brown, marketing vice president for Xerox's Information Systems Division in El Segundo, Calif. He spearheads Xerox's two-pronged desktop publishing strategy — page makeup software for the IBM PC XT and its clones, licensed from Ventura Software Inc.; and homegrown software for Xerox's own 6085 workstation. Xerox decided to target what Brown estimates are the 2.5 million installed XTs rather than IBM PC AT or Apple Macintosh machines

to avoid the herds of electronic publishing software houses developing products for the AT and Mac. (Xerox also has a commercial typesetting offering based on DEC minicomputers.)

Xerox is taking all possible marketing routes, including selling direct and through retailers as well as looking at value-added reseller (VAR) and OEM channels. Brown concedes that the different products and marketing techniques might make for some internal competition. "We want any and all," he says. "As long as the box says 'Xerox' on it, it's a major accomplishment."

Electronic publishing is getting crowded. "Like anything just really emerging, first there are lots of players and then there is a shakeout," Brown predicts. No need to ask which players will survive. "It will ring back to support and service and overall capability relating to the customer saying, 'Take care of me,'" he says.

Kodak couldn't agree more. Big customers, such as aerospace and heavy manufacturing companies, want to deal with a big vendor, asserts John Gell, product manager for Kodak's electronic publishing systems. Kodak also pursues a multitiered product marketing strategy, offering separate product lines for in-plant and commercial publishing applications. But it relies exclusively on direct sales. Kodak also has avoided developing or licensing a PC-based software publishing product because the company believes it would not sell at a high enough price to justify the expense of marketing it.

"Every single product [at Kodak] becomes a make-or-buy decision," Gell says when asked whether his company will continue to be an OEM customer of workstations and other electronic publishing peripherals. "If we could wave a magic wand, we'd like to manufacture all of it." To ensure that Kodak had adequate supplies of workstations on which to build its electronic publishing systems, the company initially took equity positions in both Interleaf and Sun. It subsequently sold its interest in Interleaf when that company emerged as a healthy competitor.

Workstations vs. PCs

Workstations face increasing competition from personal computers as the engine of choice for low- and medium-scale electronic publishing applications. CAP International, a Marshfield, Mass., market research firm that specializes in electronic publishing systems, estimates that three-quarters of all business users of PCs will use desktop publishing in some form.

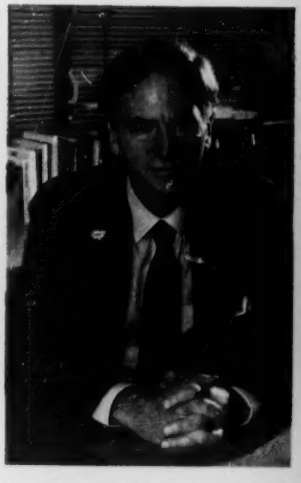
One personal computer that already has staked out firm ground in electronic publishing is Apple's Macintosh machine, whose Motorola Inc. 68000 architecture is particularly well suited to graphics applications. The Mac and Apple's LaserWriter printer family dominate the desktop publishing field. Dataquest estimates that Macintosh machines will outnumber all other types of PCs used for publishing by an 18-to-1 ratio by the end of the year. The market research firm does, however, foresee the ratio narrowing to nearly 5-to-1 by 1990.

The Mac's early lead over the IBM PC and PC-compatible computers will not be threatened for some time, insists John Scull, marketing manager for Apple's publishing products. "I'll get worried when the fundamental design architecture of the MS/DOS machine changes," he says, preferring to identify IBM PCs and PC-compatibles by their operating system than by brand name.

One element of Apple's electronic publishing strategy that could backfire is its refusal to sell publishing software or hardware other than its so-called core technologies of computers and laser printers. It leaves the opportunities to add optical memory, scanning, higher-end printers and typsetting equipment to Macintosh resellers. So far its much-publicized VAR encouragement program has produced few results.

Workstations face increasing competition from personal computers as the engine of choice for low- and medium-scale electronic publishing applications

IBM, on the other hand, seems eager to buy and market outside products in order to produce what the company's Quackenbush



APPLE's CEO Sculley: "We will not stand still as the MS/DOS world addresses graphics and ease-of-use issues"

terms best-of-breed publishing systems.

Michael Solomon, vice president for sales and marketing for Aldus Corp., the Seattle company that makes the "Pagemaker" software that runs on the Mac, points out another potential Apple weakness. The Mac's closed environment "allows fewer third-party developments," Solomon says. That could cut Apple's dominance in the market. PCs, on the other hand, have an open environment.

Apple, however, may very well eliminate such criticism this year by introducing open-architecture workstations. "We will not stand still as the MS/DOS world addresses graphics and ease-of-use issues," vows John Sculley, chairman and chief executive of Apple.

Additional material for this article was contributed by associate editor David Card.

Lianne Enkelis

Investments in publishing systems spurred by savings

Electronics companies are buying electronic publishing equipment in the hope of saving money and reducing time to market

By Nancy McSharry

IBM last year spent more than $500 million on electronic publishing systems for its own use. The investment, although large in absolute terms, may well be *below* average — accounting for only 1% of the $50 billion giant's annual sales. Analysts and consultants who have watched electronic publishing evolve from a marketing concept to a full-blown capital equipment market now estimate that companies devote anywhere from 3% to 10% of their total revenue to publishing hardware, software and services.

The market has no more devoted customers than systems makers, military contractors and their peripheral and component suppliers. All are investing enormous sums in workstations, laser printers, and the like, to take charge of meeting their own publishing requirements.

"Electronics companies with rapidly changing products and short times to market have people who are very sensitive to electronic publishing," says David Boucher, president of Interleaf Inc., one of the leading vendors of electronic publishing systems. "It may be 50% of the total electronic publishing market — at any rate, it's certainly a big chunk," he says, referring to the amount of electronic publishing systems purchased by electronics companies.

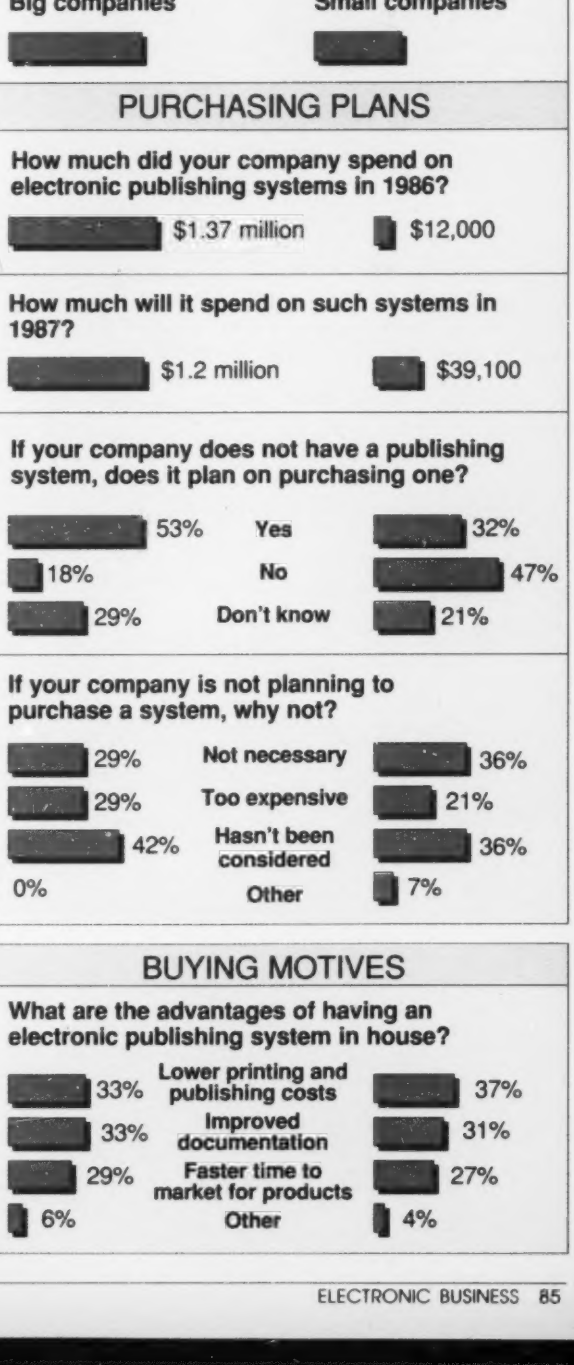
To assess how much electronics companies are investing in publishing systems and to determine how they are managing such investments, ELECTRONIC BUSINESS recently surveyed 1,000 operations and marketing managers at electronics companies. Five hundred of them were from the top 100 electronics companies, the smallest of which had $300 million in annual revenue. The other 500 were from companies with annual revenue less than $300 million. With a 10% response rate, the magazine has a 95% confidence level in its answers up to three percentage points.

Big vs. small companies

The major difference between the two classes of companies regarding electronic publishing is one of resources. Big companies have a lot more money to spend — and, no doubt, more incentive to do so — on publishing hardware and software. The average company in the top 100 last year spent nearly $1.4 million on electronic publishing systems. Its counterpart in the under $300 million category inves-

It's publish or perish

ELECTRONIC BUSINESS survey of big (more than $300 million) and small (less than $300 million) electronics companies that use electronic publishing.


Big companies
Small companies
PURCHASING PLANS
How much did your company spend on electronic publishing systems in 1986?
$1.37 million
$12,000
How much will it spend on such systems in 1987?
$1.2 million
$39,100
If your company does not have a publishing system, does it plan on purchasing one?
53% Yes 32%
18% No 47%
29% Don't know 21%
If your company is not planning to purchase a system, why not?
29% Not necessary 36%
29% Too expensive 21%
42% Hasn't been considered 36%
0% Other 7%
BUYING MOTIVES
What are the advantages of having an electronic publishing system in house?
33% Lower printing and publishing costs 37%
33% Improved documentation 31%
29% Faster time to market for products 27%
6% Other 4%

ed just $12,000. However, small companies plan to triple their publishing investments this year, while big companies may actually reduce their outlays somewhat.

Some other differences that emerge from the survey concern intent to purchase, hardware choices and vendor recognition. The majority of big companies currently without systems at least plan to buy them soon; only a third of small companies that now lack systems intend to purchase them. Big companies only exhibit a slight bias toward personal computer-based publishing systems, employing workstation-based and minicomputer-based systems nearly as much; nearly half of all small companies prefer personal computers (PCs), especially ones from Apple Computer Inc. Big companies are very much aware of the leading dedicated publishing system vendors — Interleaf, Texet Corp. and Xyvision Inc.; small companies barely know of them.

Shared objectives

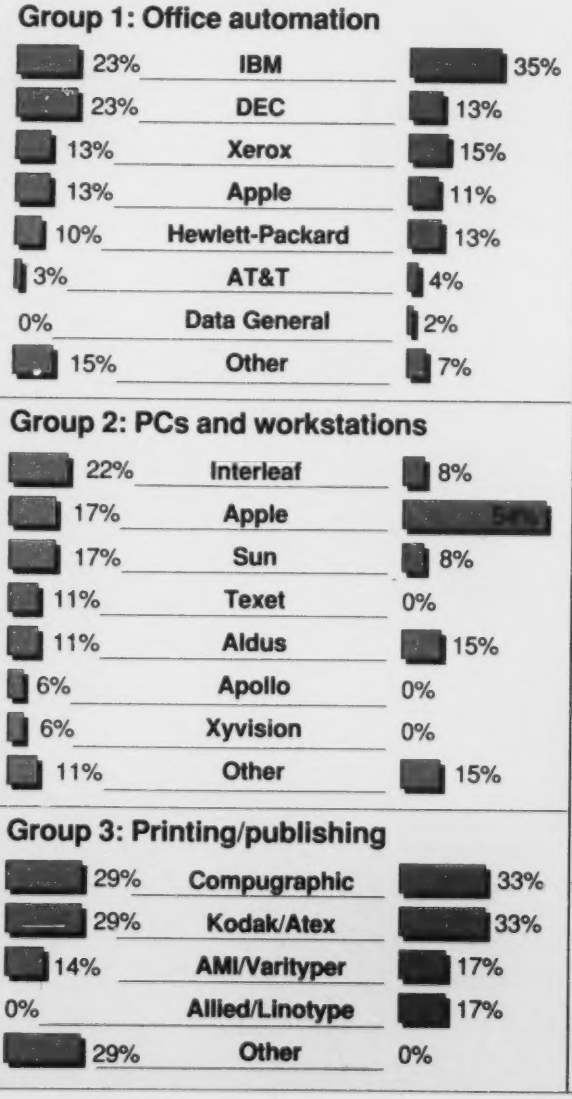
Lower printing and publishing costs are the chief objectives of both big and small companies in making an investment in electronic publishing systems. In big companies, however, improving documentation is just as big a motive. Reducing the time it takes to develop and bring a product to market is also a strong incentive for companies.

The president, chief executive or chief financial officer most often gives the final approval to buy an electronic publishing system, even though his influence is far greater in small companies. Fully 60% of the managers in small companies indicate that the president, chief executive or chief financial officer gives the big green light on systems purchases; 29% of their counterparts in big companies point to their top officers as having final approval. Interestingly, engineering vice presidents in big companies seem to have more purchasing power than their colleagues at small companies. Not so surprisingly, marketing executives exert an equal amount of influence at big and small companies.

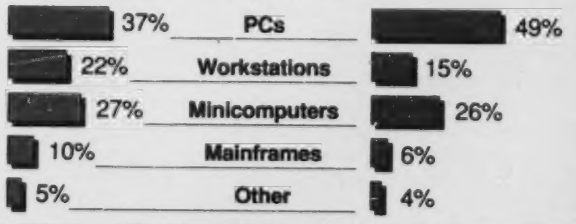
Continued

HARDWARE AND SUPPLIERS

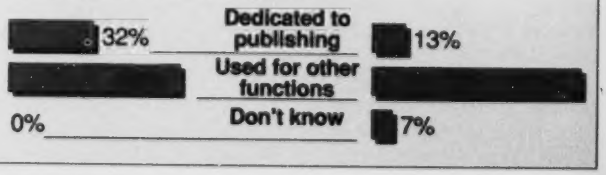
Who are your company's chief publishing system suppliers in each group?



What type of computer hardware drives your company's publishing system?



Are those hardware systems:



Organization and use

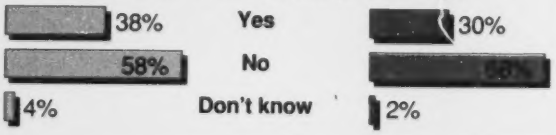
The engineering and marketing departments of big electronics companies clearly are the biggest buyers and users of publishing systems. Administrative offices, on the other hand, are where PC-driven laser printers are found in small companies. The management information system (MIS) departments in both big and small companies apparently have little use for publishing systems.

MIS professionals do seem to have some say in the selection of systems in companies where publishing committees exist. The number of committees, however, is staggeringly low in both the large and small companies. Only a third of the electronics companies surveyed by ELECTRONIC BUSINESS indicate they have committees charged with reviewing electronic publishing tools to be used by them. Where committees do exist, marketing personnel enjoy the strongest representation.

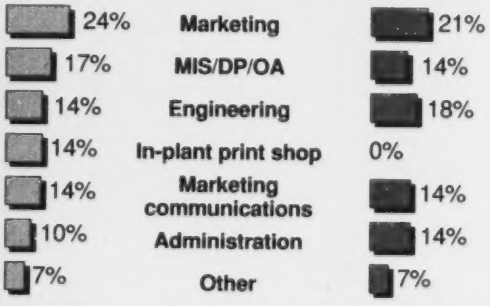
One explanation for the lack of separate publishing committees may be the fact that in a majority of cases publishing is just one of several applications of their computer hardware. Only a third of the publishing systems in big companies are strictly dedicated to the task; fewer than 15% of the systems are solely used for publishing in small companies. □

ORGANIZATION

Does your company have a committee that reviews the use of electronic publishing?



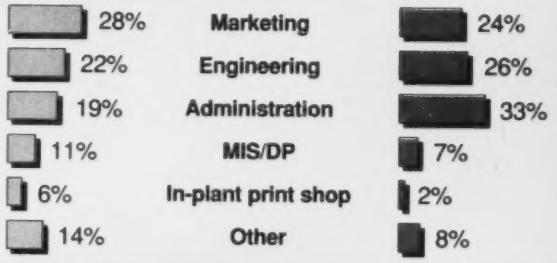
If yes, whose staff is on that committee?



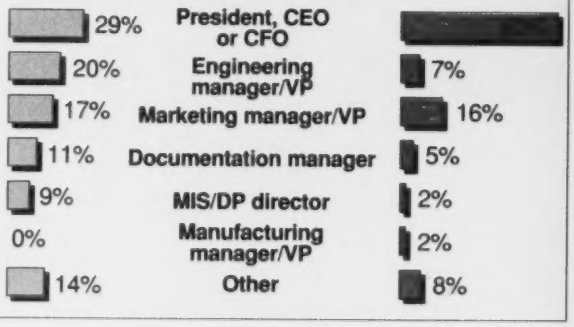
The pages of this special Electronic Publishing section were produced on an Apple Macintosh Plus by assistant production editor Kathleen Hepburn, using Aldus Pagemaker software.

AUTHORITY TO BUY

What department buys publishing systems at your company?

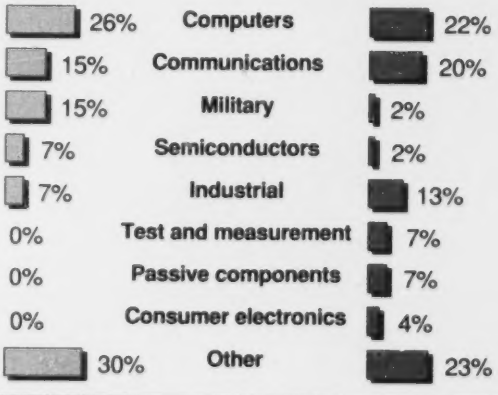


Who has final financial approval for purchasing the publishing system?



BUSINESS PROFILE

What is your company's primary business segment?



Due to multiple responses, numbers may not total 100%.

Gallium arsenide: Management can no longer ignore it

The time has come for U.S. chip producers to decide what to do with this technology. Ignoring it will only compound the problems

The major U.S. merchant semiconductor producers have three choices in gallium arsenide (GaAs): ignore the opportunity created by the technology, react to it, or develop a capability in it. For better or worse most of them have adopted a modified "ignore" approach, watching and waiting to see whether anything happens in the market.

Such an approach could be dangerous. Those companies lingering along the GaAs sidelines may be on blind side of competitors, especially Japanese manufacturers and venture start-ups. They may be placing customers at a disadvantage. And they may be giving up on a potentially attractive, high-value market.

Tom Woodard
Director of the Electronics Practice
McKinsey & Company Inc.

By Greg Summe and Bob Neely

The gallium-arsenide market can become quite attractive to U.S. electronics companies. It already has become extremely active. The number of merchant suppliers of GaAs components has tripled from 1983 to 1985. Industry and military research efforts behind GaAs are at an all-time high. IBM goes so far as to describe its GaAs research as "the largest alternative technology program at IBM." And the Pentagon has initiated a $135 million GaAs research program on the use of the compound to produce monolithic microwave integrated circuits (MMICs). (These chips achieve up to 100 gighertz frequency for ultra-reliable radar in the advance tactical fighter program, airborne-shared aperture radar and the Stategic Defense Initiative.)

Nearly all semiconductor industry sources agree that GaAs shows technical promise: It enjoys better frequency capability, radiation resistance and optical characteristics than silicon. But, the industry acknowledges that GaAs devices are difficult and expensive to make. It involves purifying both gallium and arsenic and then combining the two elements in just the right way.

But there is sharp discord over the timing and size of the potential opportunity in GaAs. Consequently, the level of commitment to GaAs varies widely among the U.S. and Japanese semiconductor producers, vertically integrated electronic equipment manufacturers and defense contractors. With a few exceptions, the U.S. semiconductor companies seem to be the least aggressive investors of these groups.

The bulk of GaAs investment being made today for the purpose of merchant sales seems to be made by Japanese IC makers (at least 12 with major programs and investments each exceeding $10 million per year) and U.S. start-ups (e.g., Gigabit Logic Inc., Gain Electronics Corp., Pacific Monlithics Inc. and Vitesse Electronics Corp.). Most traditional U.S. semiconductor producers have adopted a watch-and-wait investment approach. This may prove to be a sound strategy, but it is uncomfortably reminiscent of the transitions from vacuum tubes to transistors, transistors to ICs, and bipolar to metal-oxide semiconductors (MOS), where so many leaders in one old technology failed to embrace another new technology in time enough to maintain their positions of preeminence.

No one is predicting that GaAs will replace silicon as the dominant semiconductor type. But, it is likely to capture several high-value, performance-based segments of the semiconductor market (e.g., satellite and fiber-optic communication, ultra high-speed computers and battlefield applications). Consequently, it will be important for U.S. semiconductor producers to think clearly about their approach in determining their GaAs investments. This decision can, and should be, a systematic one, followed by substantial investment initiatives.

Greg Summe

Bob Neely

John Kenny

High price, but not for long

GaAs has far better performance characteristics than silicon due to its higher electron mobility, shorter mi-

nority carrier lifetime and direct-energy band gap structure. Such superiority currently comes at quite a price. A GaAs device frequently is orders of magnitude more expensive on a per-feature basis than a silicon-based integrated circuit with comparable functionality.

Despite the dramatic price difference, GaAs devices are being designed into a wide range of applications — principally in high-speed, high-radiation, or electro-optical environments such as direct broadcast satellite receivers, active filters for electronic warfare and fiber-optic repeaters. Those performance-based niches, of course, do not constitute a large market to date.

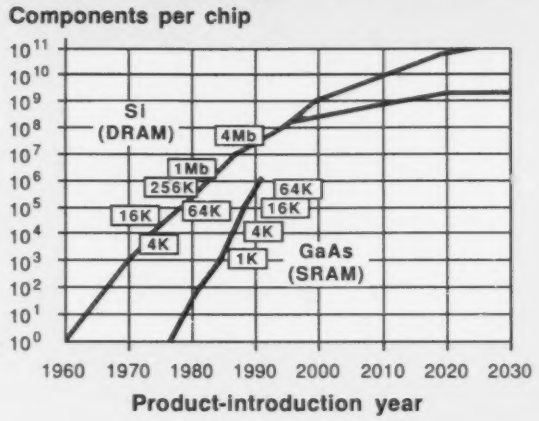
Most new technologies, however, start out that way — especially those that offer dramatic improvement in performance over their predecessors. As the cost of a new technology goes down, its appeal broadens beyond extreme performance niches. The lower cost per function permits a greater functionality at an equivalent price or the same functionality at a lower price.

For example, the transition from bipolar to MOS for most digital applications was accelerated dramatically with the introduction by Intel Corp. of the 1K dynamic random access memory (DRAM). Customers that adopted Intel's technology early (e.g., Digital Equipment Corp. and Hewlett-Packard Co.) were able to make more rapid systems advances. Even though GaAs will never replace silicon in low-cost applications, its performance advantages cannot be ignored. And on an absolute basis, it will increasingly take market share from silicon.

The most exciting markets for GaAs are ones that it will create or expand. As a result of replacing silicon in high-performance applications and expanding the market through enabling new applications, GaAs may turn out to have a much larger share of the overall electronic market than a conventional analysis would predict.

Every top semiconductor producer, therefore, should be asking itself when and how much — *not if* — it should be investing in a strong capability in GaAs. Such a producer can then lay out a capital and manpower investment plan for developing the capability. This is an important decision since even today it would probably require on the order of $50 million. To catch up in a more mature future market, the requirement could be multiples of that figure.

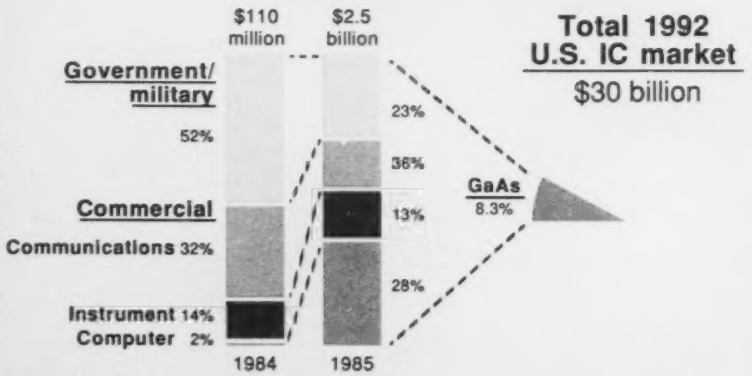
Projected progress of silicon and GaAs integrated circuits



Source: Stanford Integrated Systems Center, Gigabit Logic Inc., McKinsey & Co.

U.S. GaAs market potential

Percentage of total IC market*



*Estimates

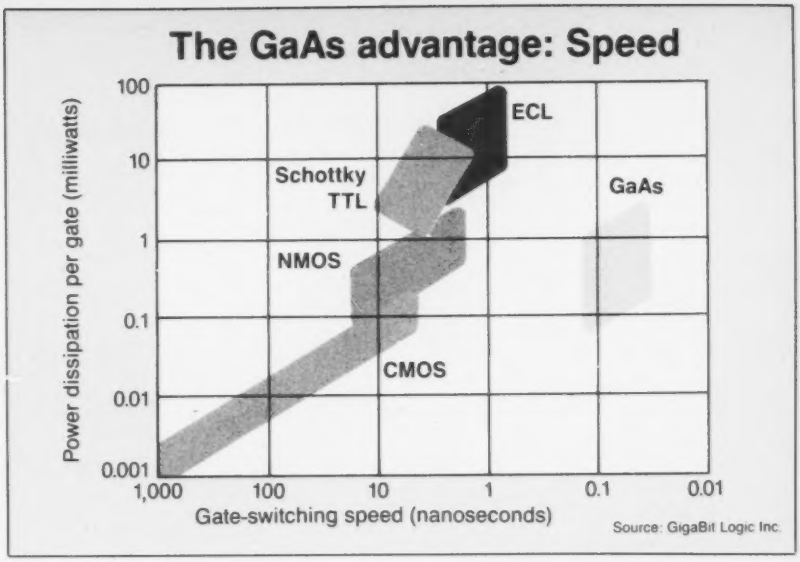
Sources: Gnostic Concepts, Integrated Circuit Engineering, McKinsey Analysis

To develop a coherent strategy for participating in GaAs, a company must start with a clear picture of the performance potential of the technology and its potential impact on the company's existing markets.

Performance potential should be determined by looking at the rate of technical progress and the ultimate potential performance limit of the technology. A useful tool for assessing such potential is the "S curve," which expresses performance versus the cumulative investment required to achieve that performance for a given technology. Typically, replacement technologies start out substantially further behind in performance and achieve clear superiority about the time the leaders in the old technology wake up too late to switch curves. Even though GaAs is clearly behind silicon in cost/complexity of design and application, today, it has higher performance potential due to its higher electron mobility.

The impact of GaAs on the company's markets will be determined by both performance and cost. The value of performance is specific to each application. For example, it is high for speed-limited computer applications and low for applications where speed is not limited. Such value is measured by determining the cost of replacing older technologies.

The value of performance is relatively static and changes slowly. The cost side of the equation, however, is very dynamic and the eventual limit much harder to assess, therefore, the cost is much harder to predict. Two common analytical traps in comparing costs are: failing to consider explicitly total system lifetime costs (including service, supplies, downtime)



and underestimating the cost decline of new technologies. To estimate cost declines it is frequently necessary to go well beyond conventional analytical techniques, especially in cases like GaAs where there are significant performance differences from the existing technology.

One useful approach is to estimate how the total system cost could evolve for functionally equivalent products. After establishing a baseline, the value of additional functionality for a specific application can be contrasted to the base cost differences. This, in turn, can help estimate the approximate time that the new technology will become cost-competitive in applications where functionality has increased.

For example, the performance and price of a 1K GaAs static random-access memory (SRAM) far exceeds its silicon counterpart. However, if the GaAs part were designed as a functional equivalent of the silicon device, the looser design rules would result in higher yields and cost would be much more competitive — perhaps falling within 50% of the silicon part. Even though GaAs and silicon are not equal as functional equivalents, such analysis helps illuminate how large the intrinsic cost differences are, and how they might change.

In some applications, the cost of achieving a solution in silicon may be prohibitive even now. Supercomputers are one such application. To build the next generation of such machines, optional computing techniques and architecture are being considered in addition to dramatically faster semiconductors. Computer manufacturers with active GaAs programs such as Fujitsu Ltd. and IBM have far greater design flexibility in the menu of architecture and component choices than those without access to blindingly quick devices.

Executing on a strategy

Once a company has a clear view of what GaAs's impact may be on its markets, the next steps are to decide what level of participation is appropriate and to organize such participation. To decide whether to adopt a reactive strategy or pursue aggressive development, the company should actively consider its product lines and market positioning.

If, for example, the company's chief product lines are low- and medium-speed complementary metal oxide semiconductors (CMOS) or if its customers are likely to continue to have lower speed applications, then a watch-and-wait strategy may be correct.

On the other hand, if the company depends strongly on high-speed bipolar products, GaAs poses a much more significant near-term threat to it than to companies dependent on MOS products. The bipolar-based company therefore should be a more aggressive developer of GaAs, attacking its own products — even at the expense of of short-term profits, if necessary. Choosing any other course is likely to result in loss of market position, since bipolar devices are the most vulnerable given their relative position on absolute performance.

If any of the major U.S. semiconductor producers is planning on increasing its participation in GaAs and protecting high-performance product areas from Japanese or start-up attack, the time is drawing near to initiate its GaAs investments. At least 12 Japanese semiconductor manufacturers, including Fujitsu, Hitachi Ltd. and NEC Corp., are aggressively trying to develop GaAs. Japanese suppliers already dominate worldwide production of GaAs wafers. Less well-funded U.S. start-ups (e.g., Gigabit Logic, Gain Electronics) are also aggressively attacking the market, even though they have not achieved the success of some better-funded domestic efforts such as Ford Microelectronics $30 million GaAs program.

The investment and organizational implications are quite different for the aggressive development approach. In a watch-and-wait mode, a company can allow existing development groups for silicon to oversee its GaAs effort and monitor industry progress, but not without some risk of neglect or over-pessimistic evaluation. To pursue an aggressive GaAs development strategy, it is important that the effort be split off from the company's mainstream silicon organization. Moreover, adequate funding will be necessary but hard to receive in most capital spending environments where silicon benefits are far more tangible and easily identified.

It takes courage as much as financial analysis to move a specific organization into a new technology. Intel, for example, showed boldness in 1983 when management mandated that it shift from n-channel MOS technology to CMOS technology. If bold moves are not taken, there is a much higher likelihood that the development will be a lot more restrained because members of the organization either resist change (it threatens their skill base) or are just not comfortable working the new technology.

Decide today, not tomorrow

The electronics industry has seen tremendous change in the last three decades. At one time it was forecast that the total market for computers could never exceed 25 mainframes. Including personal computers, the current population of computers is 15 to 20 million units worldwide.

The computer explosion vividly demonstrates the fact that potential applications for a new technology are often far larger than initially expected. GaAs promises to be one of those technologies. U.S. semiconductor producers had better decide today whether, when, and how much to participate in this potentially very attractive market.

Summe is an associate in the Hong Kong office of McKinsey & Company. Neely is a partner in the management consulting firm's Los Angeles office.